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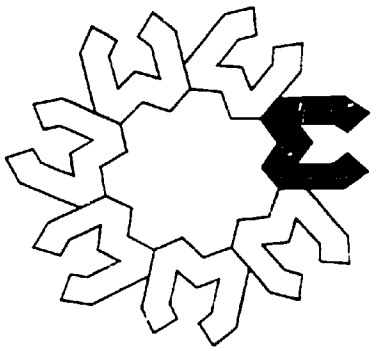
ABSTRACT

A literature search, made to provide a data base for a proposed nationwide educational telecommunications system, reviews and summarizes existing literature in the field. Educational telecommunications is divided into eight categories: instructional television, educational radio, telephone instruction, dial access information retrieval systems, information network systems, communications satellite systems, common carrier, and computer augmented learning. A ninth section deals with education and telecommunications in general. Within each category, a description of the category is followed by a brief discussion of its technology and its implication for education. In most cases the description is followed by a review of the literature in which the significance of various publications is pointed out, and the main areas of research noted. The final section presents an annotated reference for each publication. Publications which were obtained too late for review, but which appear to be of major significance, are listed without annotation. The files of the National Technical Information Service, NASA, the National Library of Medicine's AIM-TWX system, and the ERIC system were searched along with a number of libraries specializing in educational telecommunications topics. (JY)



A PLANNING DOCUMENT FOR THE ESTABLISHMENT OF A NATIONWIDE EDUCATIONAL TELECOMMUNICATIONS SYSTEM

LITERATURE SEARCH

August 23, 1971

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INTRODUCTION

The literature search documented here is part of a study to develop a planning document for the establishment of a nationwide educational telecommunications system. The study is being conducted by Synergetics, Inc., under Contract OEC-71-3955(099) with the United States Office of Education, Department of Health, Education and Welfare.

The objective of the overall study is to provide USOE with a series of plans for use as a basis for policy decisions in the establishment of a nationwide telecommunications capacity. These plans will suggest alternative policies and programs to achieve 100% coverage of the nation's population by an educational telecommunications system. The ultimate goal is to suggest actions and policies to DHEW/OE in order to facilitate this full coverage.

The basic objective of this literature search is to review and summarize the existing literature to establish a viable data base from which plans can be developed. A secondary function is to provide USOE and any other interested parties with a recent and relevant annotated bibliography for reference.

In order to facilitate the use of this document in subsequent tasks of this study, educational telecommunications has been divided into eight separate, but not unrelated categories. In addition, publications which apply to telecommunications and education in general have been listed separately. In some instances, the assignment of particular topics to a specific category has been somewhat arbitrary.

A considerable degree of overlap between these topics may be noted. Some publications have been listed under more than

one topic, while others have been assigned solely to the most relevant category. A special effort has been made to call attention to other related categories in the review sections.

Within each category, the same general format has been followed. The first subsection presents a description of the category, briefly discussing its technology and its implications for education. In most cases, the description is followed by a review of the literature in which the significance of various publications is pointed out and the main areas of research are noted. The final section presents an annotated reference for each publication. Publications listed without annotations are those that, although not obtained in time for review, appear to be of major significance. In the notations, the major points of the document are summarized with perhaps a brief mention of the nature and level of sophistication of the publication. The "B" or the "R" which follows many of the references indicates the number of bibliography or reference notes found in the publication.

In conducting this search, several techniques were used to locate titles of possible relevant materials. Computerized and personal searches were conducted through the files of the National Technical Information Service, NASA, the National Library of Medicine's AIM-TWX system, and most significantly, the Office of Education's ERIC system. To avoid being innundated with more information than could be handled. the search was generally limited to the last three years and journals of a brief or general nature were excluded. In addition, a number of libraries specializing in educational or telecommunications topics were visited. These included the Federal Communications Commission, The National Association of Educational Broadcasters, and the National Education Association.

Based upon titles and organizations suggested by the results of this search, letters were sent to many active researchers and organizations requesting current literature and additicnal information.

Finally, but perhaps most importantly, personal contacts have been made with officials of many organizations and companies doing work in educational telecommunications and related fields. Many of these individuals were kind enough to give us materials and suggest further leads. However, because of time limitations it was impossible to follow up all leads and publications.

In an effort to avoid being overly inclusive, an attempt has been made to emphasize key reports and research performed by major authorities in the field. An attempt has also been made to include a broad range of sophistication in the materials, pointing out general introductory publications and highly technical reports. The inclusion or exclusion of a document has been based upon the needs of this study and the document's relationship to it.

I. Educational Telecommunications Systems

In the general field of instructional technology, educational telecommunications is one of several categories that also include teaching machines, audio-visual instruction, microteaching using video tape recorders, and many others. Some facilities, delivery systems, or materials cross the various categories and are considered here only in their educational telecommunications roles. For example a film shown over a closed circuit television system (CCTV) is part of the materials of educational telecommunications and is considered in this study; if the same film is projected in a classroom or auditorium it is considered to be in the audio-visual category and is excluded from this study.

Telecommunications, itself, includes many subcategories that have been excluded from this study (e.g., mail, semaphore, visual signals) since the study is delimited to electronic telecommunications systems. A further limitation excludes telephone, intercom, and other electronic systems used for educational administration or bookkeeping. The study will deal mainly with systems and their interconnection without particular concern about the programs or software (instructional material) that will be transmitted over them. It is assumed that all systems will have information sources for input and display devices for presenting the data whether it be audio-video, graphic, or alphanumeric. The primary thrust of the study is to compare methods of getting a given message from one point to another. Assuming that telephone lines, microwave relays, direct broadcast relayed by synchronous satellite, and cables can all transmit signals, the question arises as to which are the most economical delivery systems for covering 100% of the population of the 50 cities

of the U.S.A. It appears that in densely populated cities such as New York and Philadelphia cables will prove to give the best signals. On the other hand, remote areas of mountainous states such as Montana, Colorado, and Alaska will undoubtedly end up receiving signals via satellite. The most economical coverage of areas between these extremes is the subject of the study to follow.

This section also notes items pertaining to Instructional Technology that have a relationship to telecommunications.

It should be noted that the To Improve Learning reports constitute a recent, overall review of the entire Instructional Technology field.

REFERENCES

Allen, William H. Trends in Instructional Technology - the Eric at Stanford 1970 Planning Report. Stanford Calif.: ERIC Clearing house on Educational Media and Technology, November 1970, 31 p.

This report contains a survey of opinion from a variety of instructional technology leaders. The emphasis is placed on instructional materials and the systems approach.

American Society for Engineering Education. The Application of Technology to Education. Washington, D.C.: 1969, 39 p.

This publication is the report of a symposium to evaluate the potential technological advances in terms of cost effectiveness and feasibility within the existing educational framework.

Beckwith, Hugh. Innovation in Industry Likely to Affect Instructional Technology During the Next Ten Years. In Tickton, S.G. (Ed.). To Improve Learning V.2. pp 845-857.

This report undertakes to examine technological developments likely to occur in the next ten years as a result of industrial innovation that can have a significant effect on instructional technology.

Bretz, Rudy. Communications Media: Properties and Uses, Memo. RM-6070-NLM/PR. Prepared for National Library of Medicine and U.S.A.F. Project Rand. Santa Monica, Calif.: The Rand Corp., September 1969, 113 p. R.-14.

The memorandum defines and describes communication media; discusses the difference between information and instruction. instructional media and instructional aids; and proposes a set of criteria by means of which communication media may be distinguished from nonmedia, one medium distinguished from another, and discrete media distinguished from multimedia applications. Communication media are divided into two groups, telemedia and recording media.

Bretz, Rudy. The Selection of Appropriate Communication Media for Instruction: A Guide for Designers of Air Force Technical Training Programs. A report prepared for United States Air Force Project Rand. Santa Monica, Calif.: The Rand Corp., February 1971, 65 p. R.-10

Based on the author's communication's media classification system, guidelines are suggested for the classroom teacher to choose appropriate media.

Carpenter, C.R. The Commission on Instructional Technology and Its Report. Educational Broadcasting Review. April 1970, Volume 4, Number 2.

This is a review of To Improve Learning. It provides a useful summary of the major points raised by the Commission on Instructional Technology.

Carpenter, C.R. Teleinstruction and Individualized Learning. In Tickton, S.G. (Ed.). To Improve Learning V.2. pp. 15-24.

The term "teleinstruction conveys the concept of the use of equipment, processes and procedures which provide instruction or the stimulation of learning at a distance from the original source of the stimulous materials." Various techniques of teleinstruction are discussed.

deLone, Richard H. Sketching a Context for Instructional Technology. In Tickton, S.G. (Ed.). To Improve Learning V.2. pp. 39-50. R.-5.

In an overview of computer technology as applied to education, the author postulates three possible societal outcomes of the computer age and examines their implications for education. He suggests questions, approaches, paradoxes, and tests that must be faced for each outcome. Educators will be delinquent if they plunge into technologizing instruction without first taking a hard look at where they are going, what their assumptions are, and what basic changes in the education system must be made if technology is going to make any impact, any real difference to the students. A short description of the application of this technology in Philadelphia is presented.

Dempsey, Rev. Michael J. Relationships between the Restructing of Schools and Communications Technology. In Tickton, S.G. (Ed.). To Improve Learning V.2. pp. 51-56.

Schools will find it necessary to change traditional structures to fully utilize instructional technology. The educational or Catholic schools is discussed. Changes to date where technology has been used are considered.

Dordick, H.S. The New Communication Technology and For What? Rand Corporation. May 1968. 23 p. B.-9.

Predictions of future developments in mass communications. Communication capacity will increase many times to meet demand. Space communications will make expansion of systems possible within a reasonable cost.

Dordick, H.S., Chesler, L.G., Firstman, S.I. and Bretz, R. Telecommunications in Urban Development. Rand Corp. July 1969. 161 p. R.-57. B.-27.

This memorandum describes a study which investigated the role of communication in urban situations, including education. A demonstration project 5 recommended to test the effects of a full scale communications system.

Doyle, Frank J. & Goodwill, Daniel Z. An Exploration of the Future in Educational Technology. Bell Canada, January 1971. 70 p. B.-11.

This is the report of a Delphi study constructed to examine education in 1990. Telecommunications and technology will cause great changes in the nature of education. Transitional problems, predicted to occur over the next ten years, are discussed.

General Learning Corporation. Cost Study of Educational Media Systems and Their Equipment Components. In Tickton, S.G. (Ed.). To Improve Learning V.2. pp. 955-964.

This is a brief summary of a very detailed cost analysis performed on total media system. The models used in the analysis are described and a summary of the conclusion is presented.

Ginther, John R. Technology, Philosophy and Education. In Tickton, S.G. (Ed.). To Improve Learning V.2. pp. 75-88.

The responsibility in the failure to apply technology to education is assessed, and a discussion of the deterrents to its application is presented. Most objections and obstructions can be dealt with by making current information available and by providing additional research. Some educational technology issues that reflect philosophical positions are developed--issues that have been brought into sharp focus by recent discussions of the potential of technology in education.

Goldhamer, Herbert (Ed.) assisted by Westrum, Ronald. The Social Effects of Communications Technology. A report prepared for the Russell Sage Foundation. Santa Monica, Calif.: The Rand Corp., May 1970, 31 p.

The effect, in non-technical terms, of new communications systems on social systems is discussed. The communications revolution requires further insight into social conditions and situations.

Hellman, Hal. Communications in the World of the Future. New York: M. Evans and Company, Inc., 1969. 192 p.

Within the past few decades we have progressed from barely being able to communicate by voice across the oceans to interplanetary communications by picture and voice. This book presents the layman with a survey of communications from the distant past to the near future. Virtually every communications means (lasers, computers, telephones, etc.) are considered as they will be in the near term future. Particular attention is devoted to transmission systems.

Hooper, Richard. A Framework for Studying Instructional Technology. In Tickton, S.G. (Ed.). To Improve Learning V.2. pp. 139-164. B.-13.

Problems in the evaluation of the role of technology in the classroom are discussed. The key problem is to relate media organization to educational objectives.

Joint Council on Educational Telecommunication. Telecommunication for Public Service: A preliminary survey of those DHEW and other Federal programs with present or potential telecommunications components. Contract Hew-OS-71-122. 1971. 23 p.

This is a comprehehsive review of U.S. Government activities in support of telecommunications. Emphasis is placed on the Educational Broadcasting Facilities Program.

Martin, J. Future Developments in Telecommunications. Prentice-Hall, Inc. Englewood Cliffs, N.J.: 1971. 413 p.

This is a technical review of techniques used for telecommunications transmission and processing. Switching networks and digital transmission are emphasized.

Meaney, John W. and Carpenter, C. Ray (Eds.). Telecommunications: Toward National Policies for Education. Washington, D.C.: Joint Council on Educational Telecommunications, 1969, 193 p. R.-3.

This general report includes brief, but inclusive reviews of possible impacts on education by technological developments.

National Academy of Engineering. Communications Technology for Urban Improvement. Report to the Dept. of HUD. Washington, D.C.: Committee on Telecommunications. June 1971. 218 p.

The role of total telecommunications systems in urban situations is discussed. The emphasis is on future development to insure desired coverage of all services.

Norwood, F. Telecommunications Program Affecting Network Development. In Becker, J. (Chem.). Conference on Interlibrary Communications and Information Networks.

This is a review of recent technological and political developments affecting telecommunications systems. Resulting potentials are discussed using newly available techniques.

President's Task Force on Communications Policy: Final Report and Staff Papers. Washington, D.C. Government Printing Office. December 7, 1968 and 1969.

This document and its related staff papers represents a major attempt to determine the needs for governmental action in telecommunications. The final report briefly discusses the impact of various technologies on society. The staff papers discuss these technologies in much greater detail. Of special interest is the final staff papers, which is a bibliography of sources used in preparation for this series of reports.

Tickton, Sidney G. (Ed.), with the Staff of the Academy for Educational Devleopment, Inc. To Improve Learning: An evaluation of instructional technology. New York and London: R.R. Bowker Company, 1970. 2 Vols. Vol I 441 p.; Vol II 1096 p.

This is the report of the Commission on Instructional Technology and a selection of papers prepared for it covering all aspects of instructional technology. Some of the specific papers are listed elsewhere in the literature search. Volume One contains the Commission's report and selected working papers, while Volume Two contains varied papers on instructional technology theory, practice, and implications.

Weisgerber, Robert A. (Ed.). Instructional Process and Media Innovation. Chicago: Rand McNally & Co., 1968, 569 p.

Several authors examine the instructional process from different viewpoints. The emphasis of this book is placed on the use of human resources in the education process; thus, it deals with a study of those elements in the instructional process which are appropriate for technological implementation. The book is organized around generic principles; educational levels; curriculum programs; the major media and evolving technologies are practical steps towards instructional implementation of media. The book also emphasizes the utilization of technology in education--and to a lesser degree and depth of media production, facilities and environment, theory, and administrative logistics.

SOPHISTICATION INDEX

This index presents a listing of articles concerning Educational Telecommunications System, in three levels of sophistication. These levels are defined as follows:

Level 1 - Introductory material.

Level 2 - Requires basic knowledge and awareness of terms.

Level 3 - Requires extensive background knowledge in the area, plus technical or analytic background (usually of interest to the specialist).

Level 1

Allen, William H. Trends in Instructional Technology.

Hellman, Hal. Communications in the World of the Future.

Meaney, John W. and Carpenter, C. Ray (Eds.). Telecommunications: Toward National Policies for Education.

Level 2

American Society for Engineering Education. The Application of Technology to Education.

Beckwith, Hugh. Innovation in Industry Likely to Affect Instructional Technology During the Next Ten Years.

Bretz, Rudy. The Selection of Appropriate Communication Media for Instruction: A Guide for Designers of Air Force Technical Training Programs.

Carpenter, C. R. (Ed.) and Meaney, John W. Telecommunications: Toward National Policies for Education.

Carpenter, C. R. Teleinstruction and Individualized Learning.

deLone, Richard H. Sketching a Context for Instruc'ional Technology.

Dempsey, Michael J. Relationships Between the Restructing of Schools and Communications Technology.

Dordick, H. S. The New Communication Technology and For What?

Dordick, H. S., Chesler, L. G., Firstman, S. I. and Bretz, R. Telecommunications in Urban Development.

General Learning Corporation. Cost Study of Educational Media Systems and Their Equipment Components.

Goldhamer, Herbert (Ed.) and Westrum, Ronald. The Social Effects of Communications Technology.

Hooper, Richard. A Framework for Studying Instructional Technology.

National Academy of Engineering. Communications Technology for Urban Improvment.

Norwood, F. Telecommunications Programs Affecting Network Development.

President's Task Force on Communications Policy. Final Report and Staff Papers.

Tickton, Sidney G. (Ed.), with the Staff of the Academy for Educational Devleopment, Inc. To Improve Learning: An Evaluation of Instructional Technology.

Weisgerber, Robert A. (Ed.). Instructional Process and Media Innovation.

Level 3

Bretz, Rudy. Communications Media: Properties and Uses.

Doyle, Frank J. and Goodwill, Daniel Z. An Exploration of the Future in Educational Technology.

Ginther, John R. Technology, Philosophy and Education.

Martin, J. Future Developments in Telecommunications.

AUTHORS' INDEX

I. EDUCATIONAL TELECOMMUNICATIONS SYSTEM

Dordick, H. S. The New Communication Technology and For What?

Dordick, H. S., Chesler, L. G., Firstman, S. I. and Bretz, R. Telecommunications in Urban Development.

Doyle, Frank J. and Goodwill, Daniel Z. An Exploration of the Future in Educational Technology.

Firstman, S. I., Bretz, R., Chesler, L. G., and Dordick, H. S. Telecommunications in Urban Development.

General Learning Corporation. Cost Study of Educational Media Systems and Their Equipment Components.

Ginther, John R. Technology, Philosophy and Education.

Goldhamer, Herbert (Ed.) and Westrum, Ronald. The Social Effects of Communications Technology.

Goodwill, Daniel Z. and Doyle, Frank J. An Exploration of the Future in Educational Technology.

Hellman, Hal. Communications in the World of the Future.

Hooper, Richard. A Framework for Studying Instructional Technology.

Joint Council on Educational Telecommunication. Telecommunication for Public Service: A Preliminary survey of those DHEW and other Federal program- with present or potential telecommunications Components.

Martin, J. Future Developments in Telecommunications.

Meaney, John W. and Carpenter, C. Ray (Eds.). Telecommunications: Toward National Policies for Education.

National Academy of Engineering. Communications Technology for Urban Improvement.

Norwood, F. Telecommunications Programs Affecting Network Development.

President's Task Force on Communications Policy. Final Report and Staff Papers.

Tickton, Sidney G. (Ed.), with the Staff of the Academy for Educational Development, Inc. To Improve Learning: An Evaluation of Instructional Technology.

Weisgerber, Robert A. (Ed.). Instructional Process and Media Innovation.

Westrum, Ronald, and Goldhamer, Herbert (Ed.). The Social Effects of Communications Technology.

II. INSTRUCTIONAL TELEVISION (ITV)

A. DESCRIPTION

Instructional television is a generic term for television used as an aid in the instructional process. As such, it may be used both as a substitute for classroom learning and as a supplement to classroom learning, thus permitting a greater concentration of resources to be directed at a wider audience.

In this context, ITV is considered to consist of four delivery systems: (1) Community Antenna Television (CATV) also known as cable television; (2) Closed Circuit Television (CCTV); (3) Instructional Television Field Service (ITFS); and (4) Video Recording (VR). A fifth delivery system, Educational Television (ETV), has not been discussed separately; it is described under ITV and the pertinent literature is covered under the ITV References.

Also, in this concept, a distinction has been made between ITV and ETV, which is also known as Public Television. The major points of difference are shown in Table II-1. Although non-commercial in nature, ETV stations must compete on the same dial with popularly oriented programs on commercial stations. Thus, because most ETV stations frequently are dependent upon financial support in the form of contributions from their audiences, programming tends to be directed toward larger, mass audiences, although it tries to maintain a relatively higher cultural level than commercial broadcasting. A major factor affecting ETV stations is that their facilities must, by law, meet the same technical standards as the commercial broadcasters, resulting in high equipment and operating costs.

ITV, on the other hand, is directed at a specialized, easily identified audience. Although ETV facilities can be, and often are, used to broadcast ITV programs to schools, ITV can most efficiently reach its target audience through any one of the other delivery systems named above, all operating as essentially "closed circuit" systems, free of demanding FCC technical standards.

TABLE II-1 COMPARISON OF ETV AND ITV

Educational Television	Instructional Television
General programming broadcast to the general public	Specific programming directed toward a specified audience, usually in a formal instructional situation
"Open circuit", can be received with standard TV receivers	Closed circuit (ideally)
Distributed by broadcast and CATV	Distributed by ETV, CCTV, CATV, ITFS, or video tape
Expensive, high quality equipment required, often color equipment	Low cost equipment permissable
Not exclusively used to distribute ITV programming	Instructional programming exclusively
Existing interconnected network	Operated and programmed by educational institutions

The greatest flexibility in the utilization of ITV materials is possible using central distribution locations which can transmit programming simultaneously to a theoretically unlimited number of classrooms. Under these essentially "closed-circuit" systems, the central source can distribute live, taped, or filmed material to an exclusive audience at a number of locations over a wide area. Two of these systems, Closed Circuit Television (CCTV) and Cable Television (CATV) utilize wired connections between the distribution point and receiver. The third system, Instructional Television Fixed Service (ITFS), sometimes also known as 2500 MegaHertz (MHz) TV, is a broadcast system involving special frequencies, antennas, and converters for reception. Microwave can also be used for point-to-point transmission, but costs are very high.

The distribution center is the heart of any ITV system regardless of the delivery system used. Some centers may be little more than libraries obtaining video tapes from outside production sources and passing them along. Other centers may have the technical facilities and sophistication to produce and distribute several channels of programming throughout the day. These latter centers require live cameras, video tape recorders with recording capability, and associated switching and video processing equipment. Ideally they should also have film chain equipment to transfer film to the television screen.

Depending upon the level of sophistication of the equipment (monochrome or color, number of studios, etc.) costs of the studio facilities can range from a few thousand dollars to hundreds of thousands of dollars. Many ITV systems, however, function with little more than a couple of inexpensive vidicon cameras, and related equipment.

The most important component of an ITV system, however, is the programming itself. Here standards may vary from highly professional productions prepared by experienced and creative technical crews operating on a very high budget to small, low cost productions staffed by student help. Some ITV programming may involve elaborate demonstrations and other instructional devices, while many ITV programs are nothing more than an instructor lecturing before a camera.

A considerable amount of experimentation has been done with ITV production techniques in an effort to simplify and improve it. These include "self-directed" systems in which the instructor controls the camera remotely while he is teaching.

ITV operators must also be aware of copyright laws that affect their use of recorded materials. Although these laws are being reviewed, and will likely be changed, there are some areas that the ITV system operators must be aware of to protect themselves.

The question of what constitutes effective ITV programming is most basic to its utilization. The need is for programming that can draw and hold students' interest while still maintaining an adequate level of content at a reasonable cost.

B. REVIEW

Research on Instructional Television has, for the most part concentrated on its facilities or its utilization although many articles and papers provide an overview of both. Facilities research includes that on the hardware and equipment necessary to operate ITV systems, as well as any analysis work. Utilization is a much broader term, and includes the capabilities and role of ITV in the classroom.

Perhaps the best overview of ITV can be found in Frederick Breitenfeld's article in To Improve Learning although more detailed coverage is found in Stanford University's Institute for Communication Research report, Learning From Television: What the Research Says, and in the National Association of Educational Broadcasters' (NAEB) Toward A Significant Difference: Final Report of the National Project for the Improvement of Televised Instruction, 1965-1968. Both of these major studies evaluate the state of development of ITV and its classroom effectiveness and both emphasize certain faults and weaknesses in the use of television in instruction.

For the less technically and academically oriented reader, NAEB has prepared a booklet, Television in Instruction: What is Possible, which describes ITV equipment, present and future, and tells what television can and cannot do in the classroom. Several publications of the National Education Association's (NEA) Division of Education Technology provide guides to ITV primarily directed towards the educator.

NAEB has also produced a valuable guide, Television Cartridge and Disc Systems: What Are They Good For?, to the

new cartridge TV systems which provides technical specifications and possible implications of their development. This is an area in which a good deal of new work can be anticipated as new products come into general use.

Other good sources of general data on ITV is a publication of the Commission on Education of the National Academy of Engineering, Educational Technology in Higher Education. This document, however, concentrates on the uses of ITV in higher education, which are considerably different from those of primary or secondary education.

Rudolph Bretz at RAND has done a great deal of work in communications and his evaluations of several different ITV systems are useful. Some of his more theoretical work pertaining to communications will be found in other sections of this literature search.

The Carnegie Commission Report on Educational Television (James Killian, Public Television) is widely known as being the major report on ETV broadcasting. However, by self-admission, it has largely ignored ITV and is primarily valuable to those interested in "public" or open-circuit television broadcasting. Similarly, the Final Report of the President's Task Force on Communication Policy only briefly mentions ITV in its treatment of other television systems.

Two examples of programming designed to meet specific educational goals are described in NEA's Television for World Understanding and Samuel Y. Gibbon, Jr. and Edward Palmer, Pre-Reading on Sesame Street. The latter report in particular describes how the goals have been successfully met through ITV programming broadcast over ETV facilities.

Significant experience with ITV has been gained through systems and experiments performed in other countries. Bernard Trotter's Television and Technology in University Teaching, for example, indicates probable directions for the future. It provides considerable information on "open universities" in which instructional materials are presented to the general population over ETV facilities.

Other domestic descriptions of ITV systems and experiments can be found in Bretz's reports (also see his reports included under dial-access systems in Section V) and in a single issue of Proceedings of the IEEE by Charles Martin-Vegue, et.al., and by Charles R. Vail.

Many of the articles found in the second volume of To Improve Learning include ITV in their discussions of the interrelationship of various instructional media. Cost comparisons based on systems can be found here and also in Sidney Alexander's article in Public Television and in Johnson and Dietrich's Cost Analysis of Instructional Technology.

The other areas in this literature search in which television technology plays a role are Dial Access (Section V), Information Systems (Section VI), and Communications Satellites (Section VII).

REFERENCES

Aleinikoff, Eugene N. Educational Television-A Non-Commercial Viewpoint. Educational Broadcasting Review. April 1969, pp. 25-33. B.-33.

This article, written by an attorney, active in ETV, traces current problems and threats posed by proposed revisions of the copyright law. Current and proposed copyright laws have wide implications for ETV broadcasters.

Alexander, Sidney S. Costs of a Nationwide Educational Television System. Public Television-A Program for Action. New York: Harper & Row, 1967, pp. 135-192.

This document describes the costs and facilities necessary to achieve full ETV coverage of the U.S. by 1980. The assumptions and figures are necessarily rough, but cost and organizational trends can be determined. Financing is also discussed.

Baruch, Jordan J. Interactive Television: A Mass Medium for Individuals. (EDUCOM Position Paper) Boston, Mass: EDUCOM, October 1969, 70 pages.

A system for interaction with television signals is described. Sampling techniques are used to detect individual responses; still-video is selectively transmitted to a number of individual receivers from a single transmitter. Known as System-3, it is ideal for use with 2-way cable systems.

Beever, J. Engineer's Guide to Specifications for Multiple Television Distribution Systems. Philadelphia: Jerrold Electronics Corporation. 1966, 39 pp.

This is a highly technical review of equipment and practices necessary for effective distribution of television signals within a building. Systems are covered along with a discussion of ITFS equipment and proceedures.

Breitenfeld, Frederick, Jr. Instructional Television: The state of the art. In Tickton, S.G. (Ed.). To Improve Learning, pp. 137-160.

This article presents a comprehensive coverage of all facets of ITV-ETV operations, including equipment and utilization. The political factors affecting ITV operations are also briefly discussed, and short descriptions of a number of outstanding ITV experiments are included.

Bretz, Rudy. Color Television in Instruction. Rand Corporation, June 1970, pp. 7, D.-2.

Despite national trends to Color Television, its value in ITV is questionable, particularly in view of its cost. Low cost equipment does not seem to meet necessary standards, and bad color seems to be worse than no color. Color technology is not yet advanced enough to be valuable in educational situations.

Bretz, Rudy. The Self-Directed System: A Simplified Production Method for Instructional Television. Santa Monica, California: Rand Corporation, 1969, pp. 22.

"Self Directed" television requires no production crew since the instructor handles all switching and camera work. This technique has been used by the "GENESYS" system in Florida which is described in detail. Simplified production does not eliminate ITV versitility. Audio talk back can be a very valuable addition to the system.

Bretz, Rudy. Television and Ghetto Education: The Chicago Schools Approach. Santa Monica, California: Rand Corporation, June 1969, pp. 16, B.-9.

ITV can be used to help combat traditional deficiencies of inner city schools. ITV in Chicago is described here, with each area within the city maintaining its own ITV system geared to local needs. Close relationship between TV teacher and school staffs result with ITV being used to provide both basic and supplemental instruction and the classroom teacher giving special attention to the individual student. Costs and future recommendations are included.

Chu, Godwin G. and Schramm, Wilbur. Learning from Television: What the Research Says. (Summary of Major Observations from the Report). In Tickton, S.G. (Ed.). To Improve Learning. pp. 179-182.

This is a summary of the major conclusions of this key 1967 study done by Stanford's Institute for Communication Research. It looks at ITV from these points of view: (1) how much is learned from ITV, (2) how ITV can be used most efficiently, and (3) under what circumstances did teacher and student attitudes about ITV compare favorably with their attitudes toward other instructional media.

Commission on Education. National Academy of Engineering. Educational Technology in Higher Education: The Promises and Limitations of ITV and CAI. A report of the Instructional Technology Committee. September 1969, pp. 22, B.-50.

This report includes background coverage of ITV and CAI utilization in higher education. Included are descriptions of a number of projects and experiments in ITV utilization and results from research done on ITV effectiveness.

Diamond, Robert M. Instructional Television in Perspective. In Weisgerber, Robert A. (Ed.). Instructional Process and Media Innovation. Chicago: Rand McNally & Co., 1968, pp. 368-389, B.-5.

In a broad review of instructional television, this article considers its classroom drawbacks, its technical advantages and limitations, its various forms (closed- and open circuit), and its operational applications. It also presents a list of ITV objectives and suggests criteria for maximum effective use.

Frymire, L. T. Study of State Public TV Systems for the Corporation for Public Broadcasting. Naperville, Illinois: December 1969, 185 pages.

This is a survey of the status of interconnection and station development plans on statewide basis. ETV organization and station coverage is discussed.

Gable, Martha A. Instructional Television and Other Forms of Educational Technology Serving Needs in Urban Areas. In Tickton, S.G. (Ed.). To Improve Learning. V.2. pp. 575-594.

ITV has been less than successful because of flaws in its presentation. The ideal role of TV teacher is discussed, along with a survey of sources for instructional programs. Creative use of TV can contribute much to a classroom, particularly where students are hostile or indifferent to traditional techniques. Materials should be personalized to meet local needs.

Gibbon, Samuel J., Jr. and Palmer, Edward L. Pre-Reading on Sesame Street. Children's Television Workshop. June 1, 1970. Taken from a more comprehensive report submitted to the Committee on Reading of the National Academy of Education. pp. 85.

This article describes the development of and the rationales for the production techniques used in this exceptional ITV experiment. The educational goals are presented along with the production techniques used to achieve them. Although "Sesame Street" is an unusually outstanding example, this paper indicates the necessary steps to achieve educational goals in ITV, concentrating on the capabilities and limitations of the target audience.

Herman W. Land Associates. Television and the Wired City--A Study of the Implications of a Change in the Mode of Transmission. Prepared for the President's Task Force on Communications Policy. Washington, D.C.: National Association of Broadcasters. August 1968, 256 pages.

This National Association of Bradcasters commissioned study of impact of "wired city" concept on broadcasting deals with diversity in television programming. Oriented towards broadcasters' point of view, it describes activities of broadcasters in the public interest, including educational programming.

Hudson, Robert B. The Future of Educational Television. In Tickton, S.G. (Ed.). To Improve Learning. pp. 267-276, B.-5.

As ITV becomes indpendent of ETV, it is going to have to develop its own methods and formats. It must also extend its range and establish a new relationship with public TV. New communications techniques, such as satellites, will have their greatest effect in developing nations and will create educational opportunities on an international scale. This is largely speculative paper.

Johnson, F. Craig and Dietrich, John E. Cost Analysis of Instructional Technology. In Tickton, S.G. (Ed.). To Improve Learning. V.2. pp. 965-976. B.-5.

In this article CCTV costs are compared with comparable non-TV teaching. Cost per student credit hour is used as basic economic unit. TV costs become more economical at a level of about 500 students.

Killian, James R., Jr. Public Television, a Program for Action. The Report and Recommendations of the Cargnegie Commission on Educational Television. New York, Evanston, and London: Harper & Row, 254 pp.

This is the major study that established the term "Public Television" as programming "directed at general community." Less concerned with ITV than Public TV, it is particularly concerned with the establishment of a public TV network. Public TV does have instructional implications, and they are discussed. Many of its recommendations have been acted upon favorably, and some have direct or indirect impact on ITV, particularly in terms of production and networking facilities.

Lewis, William C. Through Cable to Classroom. A Guide to ITV Distribution Systems. Washington, D.C., National Education Association. 1967. 44 P. B.-5.

The author presents a pictoral guide to the installation of an in-school distribution system. The technical requirements and proper installation techniques are included with many illustrations. This guide applicable to any system used to deliver a signal to a school.

Licklider, J.C.R. Televistas: Looking Ahead Through Side Windows. Public Television--A Program for Action. New York: Harper & Row, 1967, pp. 201-226.

This is innovative look at possible variation of television technology used for data or interactive purposes. Broadband TV channel can be modified to transmit vast flows of information or still images selectable from a feed of 30 pictures per second (see Section VI, Information Systems). CATV facilities can be used for "narrowcast" programming to small specific groups preferably with two-way capability. Instructional benefits of interactive television systems are also discussed.

Margin-Vegue, Charles A., Morris, Albert J., Rosenberg, Jerome M., Tallmadge, Gene E. Technical and Economic Factors in University Instructional Television Systems. In Proceedings of the IEEE. June 1971. pp. 946-953. B.-20.

This comprehensive coverage of ITV delivery systems concludes that ITFS offers best potential to universities. It includes a cost discussion of different systems and suggests utilization of several delivery systems together for greatest coverage.

National Academy of Engineering. Community Information Center. Two-Way Education Delivery Systems. Report to the Department of HUD. Chapter III. Communications Project Recommendations. Washington, D.C.: Committee on Telecommunications, National Academy of Engineering, June 1971, pp. 44-62.

The availability of low-cost communications channels and provision for student (including adult students) interaction with educational materials promises to add a new dimension to urban education. Three projects--interactive instructional television, interactive community information retrieval, and computer assisted instruction--are outlined. These projects would examine educational benefits to be gained from the use of advancing computer and cable technology.

National Association of Educational Broadcasters. Television in Instruction: What is Possible. Washington, D.C. 1970. pp. 24. Also in Tickton, S.G. (Ed.). To Improve Learning. pp. 299-312.

A brief discussion outlines the capabilities and educational theory involved in ITV. How television fits into the traditional social aspects of education is considered, and the current shortcoming of ITV is viewed as being partially a result of the need to integrate technology and education properly.

National Association of Educational Broadcasters. Toward a Significant Difference: Final report of the National Project for the Improvement of Televised Instruction, 1965-1968. Washington, D.C. pp. 39. B.-4.

This important study on the improvement of ITV places major emphasis on learning efficiency and a systems approach. The problem is that ITV is not viewed highly by educators or ETV broadcasters. The National Project for the Improvement of Televised Instruction has actively encouraged and financed ITV experiments to develop educational alternatives.

President's Task Force on Communications Policy. Final Report. Chapter Seven. Future Opportunities for Television. Washington U.S. Government Printing Office. December 1968.

Concentrating on broadcast, cable, and satellite distribution, this key report concludes that non-commercial uses of television depend upon development of ways to expand the number of available channels. Policy should encourage the use of several delivery systems.

Schuller, Charles F. Production Facilities Needed in a University to Satisfy Instructional Technology Requirements. In Tickton, S.G. (Ed.). To Improve Learning, Volume 2, pp. 493-506.

This article deals with the equipment and staff necessary for adequately producing instructional television materials on a university level. Film, audio, and CAI facilities are also discussed. Costs are briefly considered.

Trotter, Bernard. Television and Technology in University Teaching. Toronto, Canada: T.H. Best Printing Co. December 1970, pp. 84. B.-11.

This is the ITV component of a continuing study of Canadian educational technology. Canadian ITV has undergone a greater amount of development than has ITV in the U.S. and this report highlights technical, economic, and programming information gained from experience. The role of ITV in the classroom is examined in detail, as is the possible impact of new hardware, such as the cartridge TV systems. Among recommended future developments is an "open university" based upon a British model, using ETV to reach many people outside the university with instructional programs. Economic models for both open and closed circuit ITV programs are presented.

Tyler, I. Keith. Television for World Understanding. Washington, D.C.: Division of Educational Technology, National Education Association, 1970, 80 p.

This article examines the impact of television on students and its role in educational process. It includes a discussion of the role played by commercial television as ETV and ITV, in forming values, etc., and proposes programming goals designed to achieve a certain objective.

Vail, Charles R. Talkback TV at Southern Methodist University: Four Years of Experience. Proceedings of the IEEE. June 1971. pp. 954-960.

"Talkback television" has been used for advanced education in connection with a university and various employers. This article concentrates on studio-classroom techniques necessary for success. The "TAGER" system uses microwave for transmission, but will eventually convert to ITFS.

C. Community Antenna (Cable) Television (CATV)

1. Description

Community Antenna Television (CATV) or "cable television" is a system by which high-quality radio frequency (RF) signals are delivered through coaxial cable networks to subscribers who pay a small ($5 average) monthly fee. CATV is most often found in remote areas where large, expensive antenna systems would be required to bring in distant signals. CATV can provide as many as 40 channels of programming from a wide variety of sources, such as video tapes, networks, and local studios. Although in the past it was somewhat limited and restricted by uncertain regulatory policies, newly proposed FCC regulations (scheduled to take effect in the Spring of 1972) will promote and encourage the establishment of CATV systems in urban and suburban areas. The new rules will require a minimum of 20 channels, including one channel reserved for educational usage.

Possible educational uses of CATV are quire varied. Since CATV eliminates reception differences between very high frequency (Channels 2-13) and ultra high frequency (Channels 14-85) stations, it has boosted the coverage of noncommercial educational television (ETV) stations, many of which are located on UHF.

CATV can be used as a delivery system for instructional television (ITV) since when the system is properly designed and equipped, individual subscribers, or students, can respond to program material through data links. The advantage of CATV as a delivery system for ITC is that is permits integration of the ITV programming with "open circuit" program sources, while eliminating the requirement that a school system install its own interconnected delivery system. CATV is closely related to the so-called broadband communications networks and attention should be paid to the section on them in this report under "Information Systems" (Section VI).

2. Review

Because the educational implications of CATV have only recently been recognized, much of the material is in the form of periodic reports from continuing projects. Consequently, there is little that can be considered to be complete on the educational uses of CATV. However, certain points are of interest.

Barnett and Greenberg's 1967 Proposal for Wired City Television set the stage for much of the current interest in CATV. They proposed widescale urban utilization of CATV. Recently, the Ford Foundation sponsored a one-year investigation into CATV issues by the Rand Corporation, a project which has been extended by a three-year grant from the John and Mary R. Markle Foundation. The Markle Foundation is currently concentrating on education and mass communications and has also recently funded CATV studies by the Mitre Corporation and the Planning Corporation for the Arts.

Though primarily oriented towards the development of policies by the FCC, the Rand reports deal with past and potential problems in the utilization of CATV as a vehicle for the transmission of many different points of view.

Of particular concern to Rand is the relationship between CATV and the existing broadcast structure, both commercial and non-commercial. The reports confirm that non-commercial stations are aided by CATV coverage, but as observed by Leland Johnson in Cable Television and the Question of Protecting Local Broadcasting, a local ETV station may find its audiences diluted by the importation of distant signals. He also notes that the quasi-Pay-TV natur of CATV subscription may inhibit audience donations to ETV stations. Similar economic problems are dealt with by Rolla Parks' highly statistical report, Potential Impact of Cable Growth on Television Broadcasting. N. E. Feldman's Cable Television and Satellites viewed some of the future potentials of CATV, particularly as it would be expanded by the use of satellites. His Cable Television: Opportunities and Problems in Local Program Origination examined problems encountered by systems engaged in local origination. As he noted, Canadian systems, subject to greater governmental regulation, have been more successful than U.S. systems in establishing local origination programming that attracts and meets the needs of a diverse audience. Although there is a

good potential for ITV use of CATV facilities, it has not been explored by the representative systems examined beyond a few general educational programs produced in cooperation with local universities. Local origination facilities are, however, quite similar to the facilities frequently found in ITV studios. CATV local origination experiments tend to fail for financial reasons unless sufficient interest and income can be developed to support the cost of programming.

By contrast, Robert R. Stevens' The Vincennes Project: a study in ETV-CATV relationships in a non-technical CATV journal describes his successful mixture of CATV and ETV through joint ownership of an ETV station and two CATV systems by a university. A considerable amount of ITV programming has been developed for use both within the university and the general community.

A recent proposal by the FCC, known as the "Public Dividend Plan," suggests in part that 5% of CATV subscriber fees be allocated to non-commercial stations. Leland Johnson in The Future of Cable Television: Some problems of Federal regulation comments that while this appears to be a valid arrangement, some problems, such as the distribution of funds and the importation of distant ETV signals, need to be resolved. There is also a copyright problem that must be solved.

Another major investigation into CATV has been instituted by the Alfred P. Sloan Foundation under the direction of Arthur L. Singer, Jr. The Sloan Commission on Cable Communications will attempt to set orderly guidelines for the development of cable systems before events and technological developments make guidance impossible. The final report is due late in 1971, but this preliminary report sets forth key areas of concern: (1) form - the desired mixture of public and commercial emphasis within a cable system; (2) content - programming issues, particularly the ability of cable TV to serve groups not now being served by mass-appeal broadcast TV, and the possible impact of CATV on education; (3) regulation - Federal, state, and local relationships; and (4) transition - how to transform CATV from its present state to a desired format.

The National Education Association's Schools and Cable Television provides an excellent introduction to educational uses of CATV and how to most effectively obtain and use

CATV channels. The Joint Council on Educational Telecommunications JCET Data Base on CATV also provides useful introductory material. The SCOPE bibliography is a good source for journal material written about CATV.

Some additional cost information can be found on a general basis in Donald Mikes' work in Schools and Cable Television. Much more detailed cost analysis of CATV has been performed by Comanor and Mitchell for the Bell Journal of Economics and Management Science.

Perhaps more than any other area, the future of CATV lies bound up in as yet unsettled legislative, legal, and regulatory questions. The recent letter of intent from the FCC to Congress proposing new, more lienient CATV regulation may mark the beginnings of a resolution of these problems. However, these issues will be more comprehensively reviewed in the FCC/Legislative Docket Search. Good examinations of these significant problems can be found within the Leland Johnson papers or E. Stratford Smith's history of CATV for the IEEE Proceedings. A local regulatory planning viewpoint may be gained from the Mayor's Advisory Task Force on CATV and Telecommunications which deals with the establishment of CATV in New York City.

REFERENCES

Bachrach, M. Copyright - The Obstacles and Conflicts. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks, Airlie House, Warrenton, Virginia, September 28 - October 2, 1970. Chicago: American Library Association, 1971, 36 pages.

Legal problems of CATV carriage of copyrighted programs are discussed. Possible legislative implications are covered.

Barnett, H.J. and Greenberg, E.A. A Proposal for Wired City Television. Rand Corporation and Washington University. August 1967. 32 p.

This is a major document on the urban uses of CATV. Wired City Television permits increased diversity at relatively low cost. Many channels become available for many different uses, both public and commercial.

Burch, Dean. Chairman, Federal Communications Commission. Letter to Congressional Communications Subcomittees. August 5, 1971. 55 p.

FCC's proposed rules for CATV are discussed in letter of intent to Congress. Provisions include requirement that CATV systems provide at least one channel to educational interests.

Comanor, William S. and Mitchell,Bridger M. Cable Television and the Impact of Regulation. Bell Journal of Economics and Management Science. Spring, 1971, pp. 154-212.

This is a highly detailed economic analysis of CATV industry and the effect of various regulations upon it. Simulation models of CATV systems are developed, including impact of CATV providing public/educational interest channels.

Division of Educational Technology, National Education Association. Schools and Cable Television. Washington, D.C.: Division of Educational Technology. National Educational Association, 1971. 66 p.

Presented is a comprehensive coverage of educational uses of CATV. It includes a number of articles and useful appendices, as well as a good bibliography. See individual author notations.

Feldman, N.E. Cable Television: Opportunities and Problems in Local Program Origination. Santa Monica, Calif. Rand Corporation, September 1970. 31 p.

This report, one of the Ford Foundation series, includes a case study of CATV local origination systems in Canada, Virginia, and Ohio. The success or failure of the local programming appears to be dependent upon the amount of subscriber interest that can be developed. Programming must be interesting and appealing enough to support itself. This work is of value primarily in planning educational utilization of CATV channels on a supplemental basis.

Feldman, Nathaniel E. Cable Television and Satellites. Rand Corporation. August 1969. 10 p.

The combination of CATV and satellite technology is described. Adding the national resources offered by satellites to the vast capability of CATV systems, a communication system can be developed with a great amount of flexibility. This paper is a broad discussion of the potentials involved.

Gable, Martha. The What and Why of Cable TV for Schools. Schools and Cable Television. National Education Association of the U.S. 1971. pp. 7-13.

Three features make cable TV advantageous over broadcast TV: its multichannel capability, its unique two-way communications, and the greater fidelity of its transmission. For one or more of these reasons, CATV's implications for education are enormous. The author discusses the roles of members of the educational community in obtaining and using CATV facilities to maximize its potential for education.

Gargini, E.J. Dial-A-Program Communication Television. February 12, 1970. A paper delivered to the Royal Television Society. 24 p.

This paper offers an alternative form of CATV involving HF distribution through independent cables to each receiver. A dial system is used to select the program distributed to each receiver. Although cable and terminal costs are higher, channel capacity is unlimited. This system has been used successfully in England.

Hill, Roger W., Jr. Educational Consideration of CATV, Cablecasting and Telecommunications. Educational/ Instructional Broadcasting, November, 1969, 57-58, 70.

As cable TV evolves, the educational community must take advantage of the opportunity to secure a number of channels before the dollar value of the channels becomes too great. SCOPE, a regional educational service center in New York, has pioneered in writing educational provisos into city CATV franchises. The operations of SCOPE and its need are described in this article.

Johnson, Leland L. Cable Television and the Question of Protecting Local Broadcasting. Santa Monica, Calif.: Rand Corporation. October 1970. 27 p.

This report is an examination of the issues raised by the FCC's "Public Dividend Plan," prepared as the first in a series of studies for the John and Mary R. Markle Foundation. Although the plan has its primary impact in the relationship between CATV systems and the commercial broadcasters, one point of the plan would provide a percentage of CATV subscriber fees for allocation to educational broadcasters. Before the plan can be adopted, further clarification must be made as to how the funds would be distributed between local ETV stations and the national Public network. It also deals with the copyright problem as it applies to CATV.

Johnson, Leland L. The Future of Cable Television: Some Problems of Federal Regulation. Santa Monica. Calif.: Rand Corporation, January 1970, 87 p.

Part of the Ford Foundation/Rand series, this report deals with regulatory problems faced by the FCC in the CATV field. Among the issues discussed are: distant signal carriage, local origination requirements, supplemental channel utilization, and the protection of broadcast stations from CATV competition. Primarily concerned with regulation, this report contains excellent coverage of economic issues and considerations. The relationship of educational broadcasting to CATV is discussed.

Joint Council on Educational Telecommunications. CATV and Future Cable Communications. JCET Data Base. Washington, D.C. September, 1968. 4 p.

Brief, but comprehensive overview of educational uses of CATV. Relationship between CATV systems and educational institutions and potentials are discussed. Some regulatory and legal questions are covered.

The Mayor's Advisory Task Force on CATV and Telecommunications: A report on cable television and cable telecommunications in New York City. New York City. September 14, 1968, 75 p.

This report was prepared by a committee headed by Fred Friendly proposing a comprehensive CATV system throughout New York City. The report pays particular attention to planning for future technological developments. Certain requirements would be made to insure the availability of supplemental channels for municipal and community use, including educational applications. An interesting facet of this report is its emphasis on local, rather than federal regulation of CATV. Its chief value lies in the fact that it is a specific planning guide for CATV development in a specific community. It does not, however, indicate how this development has proceeded.

Mikes, Donald F. Some Cost Considerations in Planning for CATV. Schools and Cable Television. National Education Association on the U.S. 1971. pp. 23-33.

The costs to the educator resulting from CATV utilization, including equipment and possible usage costs, are presented.

Norwood, Frank W. The Future of Cable Communications. Schools and Cable Television. National Education Association of the U.S. 1971. pp. 35-38.

The potential of CATV system technology, including possibilities inherent in CATV two-way capacity and data transmission, are discussed.

Norwood, Frank W. Obtaining CATV Channels for School Use. Schools and Cable Television. National Education Association of the U.S. 1971. pp. 15-21.

CATV operators and educators should work together to assure that systems take educational needs into account. If CATV does not yet exist, educator's role can be greatly expanded, perhaps to the point of becoming the system operator. Local origination shows should also keep educational requirements in mind.

Park, Rolla Edward. Potential Impact of Cable Growth on Television Broadcasting. Santa Monica, Calif.: Rand Corporation. October 1970. 80 p.

This report presents a statistical examination of the effect of CATV on the existing broadcast structure. This report, part of the Ford Foundation/Rand series, concludes that while commercial stations are often adversely affected, non-commercial stations and stations with a high degree of public service/news programming tend to benefit from CATV coverage. This report is of a highly technical nature.

Posner, Richard A. Cable Television: The Problem of Local Monopoly. Santa Monica, Calif.: Rand Corporation, May 1970, 35 p.

A Ford Foundation/Rand report, this report analyzes the effect of CATV being, in many ways, a utility-type monopoly. Economic and service considerations must be taken into account in the granting of CATV franchises. A main service requirement should be free channels for educational uses. This document is of primary interest to planning the establishment of CATV systems.

President's Task Force on Communications Policy. Final Report. Report. Chapter Seven. Future Opportunities for Television. Washington U.S. Government Printing Office. December 1968. 59 p.

This section deals with possible challenges to be presented to the Federal Government by various developments in television technology, including CATV. The report considers CATV to be the most significant development, but voices strong concern about its impact on broadcast television. Governmental regulatory structures must be adapted to properly guide the development of CATV. This report has led to various changes in governmental structures in the Executive Branch, but has, so far, had little impact on policy.

SCOPE. Bibliography for Cable TV. Stony Brock, New York: Suffolk Educational Center, 12 pp. (mimeo).

This is a comprehensive bibliography, concentrating on periodicals with extensive legal references included.

Singer, Arthur L., Jr. Issues for Study in Cable Communications. New York: Alfred P. Sloan Foundation, 1970.

This is the preliminary report of the Commission on Cable Communications established by the Alfred P. Sloan Foundation to examine goals and potentials of CATV. Due late in 1971, the final report will deal with programming, regulatory, and local origination problems.

Smith, E. Stratford. The Emergence of CATV: A look at the evolution of a revolution. Proceedings of the IEEE, 1970, 58, 7, 967-982.

This article discusses the history of CATV. Regulatory problems are discussed, noting that despite some FCC obstruction to CATV development, systems are growing due to public demand for additional programming channels. Although broadcasters still fear CATV, the FCC is beginning to open up rules to allow greater utilization of its potentials. The primary concern is to assure the greatest possible combination of cable and broadcast services. This article may be out-of-date in its treatment of certain policy issues.

Stevens, Robert R. The Vincennes Project: a study in ETV-CATV relationships. Cablecasting, September, 1970, 23-24.

This is a description of a system operated by the author at Vincennes University in Indiana using the profits from two university-owned CATV systems to provide financial support for ETV station, WVUT. All three share production facilities and staff. CATV channels are used for in-school ITV not broadcast over station WVUT.

Wentworth, John W. Cable Television and Education. March 26, 1969. A Background Paper Prepared for The Commission on Instructional Technology. unpublished. 22 pp.

This is a summary of educational applications of CATV, submitted for, but not included in, To Improve Learning. "State-of-the-art" and frequency utilization for CATV systems are discussed.

Wigren, Harold E. The NEA's Position on Cable Television. Schools and Cable Television. National Education Association of the U.S. 1971. pp. 1-6. B. - 4.

The positions of major educational associations on CATV are discussed. Future planning is stressed with a request for 20% of channel capacity to be reserved for education. The "Public Dividend Plan" and full technological development is supported.

D. Closed Circuit Television (CCTV)

Closed circuit television in its simplest form involves putting the TV signal onto a cable which connects the distribution point to the receiver or, most often, a number of receivers. CCTV is usually limited to a single building, or group of physically close buildings, unless very expensive common carrier transmission techniques (such as microwave or telephone company interconnections) are used. Although installation costs are moderate, operating and maintenance costs are low if one considers that each school or campus requires its own distribution center and equipment.

REFERENCES

Baruch, Jordan J. Interactive Television: A Mass Medium for Individuals. (EDUCOM Position Paper) Boston, Mass.: EDUCOM, October 1969, 70 pages.

A system for interaction with television signals is described. Sampling techniques are used to detect individual responses; still-video is selectively transmitted to a number of individual receivers from a single transmitter. Known as System-3, it is ideal for use with 2-way cable systems.

Beever, J. Engineer's Guide to Specifications for Multiple Television Distribution Systems. Philadelphia: Jerrold Electronics Corporation. 1966, 39 pp.

This is a highly technical review of equipment and practices necessary for effective distribution of television signals within a building. Systems are covered along with a discussion of ITFS equipment and procedures.

Breitenfeld, Frederick, Jr. Instructional Television: The state of the art. In Tickton, S.G. (ed.). To Improve Learning. 1970, p. 140.

ITFS is viewed in relation to other ITV delivery systems. The author also discusses possible utilization of ITFS that would extend its potential.

Herman W. Land Associates. Television and the Wired City--A Study of the Implications of a Change in the Mode of Transmission. Prepared for the President's Task Force on Communications Policy. Washington, D.C.: National Association of Broadcasters. August 1968, 256 pages.

This National Association of Broadcasters commissioned study of impact of "wired city" concept on broadcasting deals with diversity in television programming. Oriented towards broadcasters' point of view, it describes activities of broadcasters in the public interest, including educational programming.

Johnson, F. Craig and Dietrich, John E. Cost Analysis of Instructional Technology. In Tickton, S.G. (Ed.). To Improve Learning. V.2. pp. 965-976. B.-5.

In this article CCTV costs are compared with comparable non-TV teaching. Cost per student credit hour is used as basic economic unit. TV costs become more economical at a level of about 500 students.

Kessler, William J. Instructional Television Fixed Service: An assessment of technical requirements. Washington, D.C.: Division of Educational Technology, National Education Association. May, 1967, 25 pages.

This document presents an excellent discussion of the technical and economic considerations involved in ITFS systems. It compares ITFS to wire or microwave delivery systems.

Norwood, Frank W. The Future of Cable Communications. Schools and Cable Television. National Education Association. 1971. pp. 35-38.

The potential of CATV system technology, including possibilities inherent in CATV two-way capacity and data transmission, are discussed.

Norwood, Frank W. Obtaining CATV Channels for School Use. Schools and Cable Television. National Education Association. 1971. pp. 15-21.

CATV operators and educators should work together to assure that systems take educational needs into account. If CATV does not yet exist, educator's role can be greatly expanded, perhaps to the point of becoming the system operator. Local origination shows should also keep educational requirements in mind.

E. Instructional Television Fixed Service (ITFS)

1. Description

Instructional Television Fixed Service (ITFS) is a form of ITV in which instructional programs are transmitted to a local area over channels in the semi-microwave band (2500-2960 MHz). In 1963 the FCC reserved 31 channels for ITFS, and now licenses them only to educational institutions in groups of four channels per system. A single, low-power (10 watt) transmitter broadcasts all four channels to schools equipped with special antennas and converters. Converters change the ITFS signals to ordinary VHF channels which can be received on ordinary TV sets with specialized reception equipment.

In a recent action, the FCC allocated three channels for two-way instructional television use by county and municipal governments. These new channels will share the 2500 MHz band with ITFS, effectively reducing the number of channels available for ITFS to 28, and will most likely be used to provide specialized training for police and fire departments.

Neither this new service, nor the assignment of educational satellite transmissions to the 2500-MHz band will adversely affect existing or future ITFS services because of this band's particular adaptability to sharing.

ITFS is the most economical ITV delivery system for transmission ranges between 15 and 20 miles. Several ITFS systems may operate in a given area with minimal interference. Each educational group is responsible for providing the ITV programming required to effectively utilize ITFS. For optimal use, this requires the capability to program four channels throughout the school day.

2. Review

The greatest amount of information on ITFS has been integrated into the literature on ITV, covered earlier in this section. Breitenfeld incorporates ITFS into an overview of Instructional Television, showing the relative advantages and disadvantages of ITFS as opposed to other delivery systems.

Martin Vegue, et al, includes a brief but comprehensive description of wide scale delivery systems, using ITFS or microwave techniques, concentrating on existing systems in

California, Florida, and Oklahoma. ITFS may find greatest utilization as the local cornerstone of wide-ranging ITV networks such as the Stanford ITV network.

The Division of Educational Technology of the National Education Association has produced two publications which serve as introductions to ITFS system planning. ITFS: What is it.....How to Plan is a good although slightly dated general introduction to ITFS, which provides a thorough treatment of considerations that must concern potential ITFS operators. A companion publication by William J. Kessler (1967) covers technical requirements and cost factors involved in ITFS installation. It, too, is particularly valuable towards comparing ITFS with wired interconnection.

Additional, and more recent, materials on ITFS are available both from the FCC (and these will be noted in the Docket Search) and from ITFS equipment manufacturers.

REFERENCES

Breitenfeld, Frederick, Jr. Instructional Television: The state of the art. In Tickton, S. G. (ed.). To Improve Learning. 1970, p 140.

ITFS is viewed in relation to other ITV delivery systems. The author also discusses possible utilization of ITFS that would extend its potential.

Cooper, Bernarr (ed.). ITFS: What it is . . .How to Plan. Washington, D. C.: Division of Educational Technology, National Education Association for the FCC Committee for the Full Development of the Instructional Television Fixed Service. 1967. 64 pages.

This is a good general introduction to ITFS, including legal, technical, and economic considerations. It includes some discussion of studio requirement and total system costs and a good, although old, bibliography.

Educational Products Information Exchange. Instructional Television Fixed Service: Educational Product Report #31. New York: EPIE. 1971, 63 pages.

ITFS history, technology, and utilization. It gives detailed data on existing and proposed systems and also on available equipment. ITFS utilization is extensively discussed.

Kessler, William J. Instructional Television Fixed Service: An assessment of technical requirements. Washington, D. C: Division of Educational Technology, National Education Association. May, 1967. 25 pages.

This document presents an excellent discussion of the technical and economic considerations involved in ITFS systems. It compares ITFS to wire or microwave delivery systems.

Martin-Vegue, Charles A., Jr., Morris, A. J., Rosenberg, J. M., & Tallmadge, G. E. Technical and Economic Factors in University Instructional Television Systems. Proceedings of the IEEE. June 1971, pp. 946-953.

This comprehensive coverage of ITV delivery system concludes that ITFS offers best potentials to universities. It includes cost discussions of different systems and suggests utilization of several delivery systems together for greatest coverage.

F. Video Tape Recording

The simplest method of ITV distribution involves connecting a Video Tape Recorder (VTR) to a television receiver. Prerecorded tapes may be distributed to the classroom from central libraries or production studios in much the same manner as 16mm films have traditionally been distributed.

Problems associated with this system involve scheduling, since each tape can only be viewed by a single group at a time, physical distribution of the tapes, and VTR equipment maintenance. Most VTR machines also usually require a semi-skilled operator, and tape wear under this system can become a major expense.

These problems may be partially alleviated by the recent introduction of extremely simple, inexpensive cartridge TV systems such as the CBS (EVR) system. Easy to operate, these systems can make ITV programming available on a mass scale at a low cost.

REFERENCES

McAdam, J. Robert, & Vento, Charles J. Portable Video Tape Recorder: A guide for Teachers. National Education Association. Washington, D. C., p. 57.

This simplified pictoral guide to equipment and simple systems includes a description of the most common systems and terminology. The booklet is essentially an introduction to what video tape is and its capabilities.

National Association of Educational Broadcasters. Television Cartridge and Disc Systems: What are they good for? Washington, D. C: February 1971, pp 57.

This is a guide to the uses and technology of cartridge TV recording systems whose particular advantages are low cost and simplicity. System capabilities vary and standardization is far off. Some systems (such as CADAVRS) will be useful for programmed recording of remotely distributed materials, others (particularly the CBS-EVR system) will not be able to record. Software development will be the major obstacle to full development, and centralized organizations should be formed to hand these problems and equipment distribution. Specifications for major systems are included.

Winslow, Ken. The Adoption and Distribution of Videotape Materials for Educational Use. In Tickton, S. G. (ed.). To Improve Learning. pp 395-432.

The author presents a history of video tape development and utilization for educational purposes. Tape library sources for instructional materials, including a representative list of programs, are covered in detail.

SOPHISTICATION INDEX

This index presents a listing of articles concerning Instructional Television (ITV), in three levels of sophistication. These levels are defined as follows:

Level 1 - Introductory material.

Level 2 - Requires basic knowledge and awareness of terms.

Level 3 - Requires extensive background knowledge in the area, plus technical or analytic background (usually of interest to the specialist).

Level 1

Alexander, Sidney S. Costs of a Nationwide Educational Television System.

Breitenfeld, Frederick, Jr. Instructional Television: The State of the Art.

Bretz, Rudy. The Self-Directed System: A Simplified Production Method for Instructional Television.

Burch, Dean. Chairman, Federal Communications Commission. Letter to Congressional Communications Subcommittees.

Chu, Godwin G. and Schramm, Wilbur. Learning from Television: What the Research Says.

Cooper, Bernarr (Ed.). ITFS: What It Is ... How to Plan.

Educational Products Information Exchange. Instructional Television Fixed Service: Educational Product Report #31.

Frymire, B. T. Study of State Public TV Systems for the Corporation for Public Broadcasting.

Gable, Martha. The What and Why of Cable TV for Schools.

Gargini, E. J. Dial-A-Program Communication Television.

Hill, Roger W., Jr. Educational Consideration of CATV, Cablecasting and Telecommunications.

Joint Council on Educational Telecommunications. CATV and Future Cable Communications.

Kessler, William J. Instructional Television Fixed Service: An Assessment of Technical Requirements.

Killian, James R., Jr. Public Television, a Program for Action.

Lewis, William C. Through Cable to Classroom: A Guide to ITV Distribution Systems.

Licklider, J. C. Televistas: Looking Ahead Through Side Windows.

McAdam, J. Robert and Vento, Charles J. Portable Video Tape Recorder: A Guide for Teachers.

Mikes, Donald F. Some Cost Considerations in Planning for CATV.

National Academy of Engineering. Commission on Education. Educational Technology in Higher Education: The Promises and Limitations of ITV and CAI.

National Association of Educational Broadcasters. Television Cartridge and Disc Systems: What are They Good For?

National Association of Educational Broadcasters. Television in Instruction: What is Possible.

National Association of Educational Broadcasters. Toward a Significant Difference. Final Report of the National Project for the Improvement of Televised Instruction, 1965-1968.

National Education Association. Division of Education Technology. Schools and Cable Television.

Norwood, Frank W. The Future of Cable Communications.

Norwood, Frank W. Obtaining CATV Channels for School Use.

President's Task Force on Communications Policy. Final Report. Chapter Seven. Future Opportunities for Television.

SCOPE. Bibliography for Cable TV.

Singer, Arthur L., Jr. Issues for Study in Cable Communications.

Stevens, Robert R. The Vincennes Project: A Study in ETV-CATV Relationships.

Tyler, I. Keith. Television of World Understanding.

Wigren, Harold E. The NEA's Position on Cable Television.

Level 2

Bachrach, M. Copyright - The Obstacles and Conflicts.

Barnett, H. J. and Greenberg, E. A. A Proposal for Wired City Television.

Baruch, Jordan J. Interactive Television: A Mass Medium for Individuals.

Bretz, Rudy. Color Television in Instruction.

Bretz, Rudy. Television and Ghetto Education: The Chicago Schools Approach.

Diamond, Robert M. Instructional Television in Perspective.

Feldman, N. E. Cable Television: Opportunities and Problems in Local Program Origination.

Feldman, Nathaniel E. Cable Television and Satellites.

Gable, Martha A. Instructional Television and Other Forms of Educational Technology Serving Needs in Urban Areas.

Gibbon, Samuel J., Jr. and Palmer, Edward L. Pre-Reading on Sesame Street.

Herman W. Land Associates. Television and the Wired City--a Study of the Implications of a Change in the Mode of Transmission.

The Mayor's Advisory Task Force on CATV and Telecommunications: a report on Cable Television and Cable Telecommunications in New York City.

National Academy of Engineering, Community Information Center. Two-Way Educational Delivery Systems.

Posner, Richard A. Cable Television: The Problem of Local Monopoly.

President's Task Force on Communications Policy. Final Report. Chapter Seven. Future Opportunities for Television.

Schuller, Charles F. Production Facilities Needed in a University to Satisfy Instructional Technology Requirements.

Vail, Charles R. Talkback TV at Southern Methodist University: Five Years of Experience.

Winslow, Ken. The Adoption and Distribution of Videotape Materials for Educational Use.

Level 3

Aleinikoff, Eugene N. Educational Television--a Non-Commercial Viewpoint.

Beever, J. Engineer's Guide to Specifications for Multiple Television Distribution Systems.

Comanor, William S. and Mitchell, Bridger M. Cable Television and the Impact of Regulation.

Hudson, Robert B. The Future of Educational Television.

Johnson, F. Craig and Dietrich, John E. Cost Analysis of Instructional Technology.

Johnson, Leland L. Cable Television and the Question of Protecting Local Broadcasting.

Johnson, Leland L. The Future of Cable Television: Some Problems of Federal Regulation.

Martin-Vegue, Charles A., Morris, Albert J., Rosenberg, Jerome M., and Tallmadge, Gene E. Technical and Economic Factors in University Instructional Television Systems.

Park, Rolla Edward. Potential Impact of Cable Growth on Television Broadcasting.

Smith, E. Stratford. The Emergence of CATV: A Look at the Evolution of a Revolution.

Trotter, Bernard. Television and Technology in University Teaching.

Wentworth, John [illegible] Cable Television and Education.

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Gable, Martha A. Instructional Television and Other Forms of Educational Technology Serving Needs in Urban Areas.

Gibbon, Samuel J., Jr. and Palmer, Edward L. Pre-Reading on Sesame Street.

Herman W. Land Associates. Television and the Wired City--A Study of the Implications of a Change in the Mode of Transmission.

Hudson, Robert B. The Future of Educational Television.

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Martin-Vegue, Charles A., Morris, Albert J., Rosenberg, Jerome M., and Tallmadge, Gene E. Technical and Economic Factors in University Instructional Television Systems.

Morris, Albert J., Rosenberg, Jerome M., Tallmadge, Gene E., and Martin-Vegue, Charles A. Technical and Economic Factors in University Instructional Television Systems.

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Rosenberg, Jerome M., Tallmadge, Gene E., Martin-Vegue, Charles A., and Morris, Albert J. Technical and Economic Factors in University Instructional Television Systems.

Schramm, Wilbur and Chu, Godwin G. Learning from Television: What Research Says.

Schuller, Charles F. Production Facilities Needed in a University to Satisfy Instructional Technology Requirements.

Tallmadge, Gene E., Martin-Vegue, Charles A., Morris, Albert J. and Rosenberg, Jerome M. Technical and Economic Factors in University Instructional Television Systems.

Trotter, Bernard. Television and Technology in University Teaching.

Tyler, I. Keith. Television for World Understanding.

Vail, Charles R. Talkback TV at Southern Methodist University: Five Years of Experience.

A. Community Antenna (Cable) Television (CATV)

Bachrach, M. Copyright - The Obstacles and Conflicts.

Barnett, H. J. and Greenberg, E. A. A Proposal for Wired City Television.

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Mitchell, Bridger M. and Comanor, William S. Cable Television and the Impact on Regulation.

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Baruch, Jordan J. Interactive Television: A Mass Medium for Individuals.

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Norwood, Frank W. Obtaining CATV Channels for School Use.

Winslow, Ken. The Adoption and Distribution of Videotape Materials for Educational Use.

C. Instructional Television Fixed Service (ITFS)

Breitenfeld, Frederick, Jr. Instructional Television: The State of the Art.

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Morris, A. J., Rosenberg, J. M., Tallmadge, G. E. and Martin-Vegue, Charles A., Jr. Technical and Economic Factors in University Instructional Television Systems.

Rosenberg, J. M., Tallmadge, G. E., Martin-Vegue, Charles A., Jr., and Morris, A. J. Technical and Economic Factors in University Instructional Television Systems.

Tallmadge, G. E., Martin-Vegue, Charles A., Jr., Morris, A. J. and Rosenberg, J. M. Technical and Economic Factors in University Instructional Television Systems.

D. Video Tape Recording

McAdam, J. Robert and Vento, Charles J. Portable Video Tape Recorder: A Guide for Teachers.

National Association of Educational Broadcasters. Television Cartridge and Disc Systems: What are they good for?

Vento, Charles J. and McAdam, J. Robert. Portable Video Tape Recorder: A Guide for Teachers.

Winslow, Ken. The Adoption and Distribution of Videotape Materials for Educational Use.

III. EDUCATIONAL/INSTRUCTIONAL RADIO

A. DESCRIPTION

Educational radio consists of programming of an educational nature aimed at a general audience. Twenty channels (one-fifth) of the FM band have been reserved for it by the Federal Communications Commission. Instructional radio, on the other hand, consists of programming of an educational nature aimed at more specific audiences and is broadcast over educational FM channels or "private" FM channels. (Although originally an "open circuit only" system, FM can provide these "private" channels through Subsidiary Communications Authorization (SCA) multiplexed subcarriers. The SCA broadcasts, riding "piggyback" on a standard FM signal require special receivers for reception and programs can thus be closed to all but the intended audience. Considerable experience has been gained with SCA instructional broadcasts at the University of Wisconsin.)

The major advantages of educational radio over educational television are cost and availability. The cost of radio is much lower than that of television, and the relatively narrow bandwith used permits a large number of channels and local coverage virtually everywhere. Because of the impact of educational television, however, the educative potential of radio has not been adequately exploited, except for tape exchange libraries such as the National Educational Radio operation at Bloomington, Indiana even though radio's lower cost provides greater opportunities than TV for networking and interconnection on a local and regional basis. In many cases, a telephone call can interconnect stations or can connect individuals with stations.

One of the key attractions for the use of educational (or "public") radio facilities for instructional programming is

that they can reach geographically spreadout special interest groups. Albany Medical College's WAMC-FM, for example, has operated continuing medical education successfully, including the use of telephone talkback.

Radio has been used successfully in the classroom as well, particularly for teaching foreign languages. By distributing materials to a class or group before the broadcast, an audio-visual presentation can be made at extremely low cost ("radiovision").

B. REVIEW

In recent years, radio has become virtually ignored as an educational medium as the concentration has shifted to television . Perhaps the most important publication on educational radio of recent years was the Herman W. Land Associates report for the National Assocation of Educational Broadcasters, The Hidden Medium: A status report on Educational Radio in the U.S. This report examined the capabilities of radio (as of 1967) and its potential. As has been true throughout its 50-year history, educational radio's primary problem seems to be funding.

Richard Forsythe's contribution in To Improve Learning includes a bibliography, which is significant because it shows that almost all of the major research into educational radio was performed prior to the advent of television. Neither Forsythe nor the Land Associates report, however, conclude that radio is dead in the age of television. Both believe that it has a significant, albeit often underrated, role to play in the educational process.

This belief is borne out by Lorne A. Parker's descriptions of the SCA system in operation at the University of Wisconsin. This system provides telephone talkback and permits a variety of types of instructional and educational broadcasting to be distributed.

However, as all these authors note, instructional radio is flourishing more today in foreign countries, and a good amount of literature should be available from other governments. The BBC has been particularly active in this field.

Educational radio, as noted previously, is closely related to telephone systems, and references to Telephone Instruction, Dial Access, and Information Systems (Sections IV, V, and VI, respectively) may yield further useful information.

REFERENCES

Forsythe, Richard O. Instructional Radio. In Tickton, S. G. (Ed.). To Improve Learning New York: Bowker, 1971, pp. 241-258. B.-41

The history and present status of educational radio is presented, including descriptions of major instructional radio programs. Radio can be used for various training and adult education purposes, and is particularly valuable when combined with telephone talkback and previously distributed books or other visual materials. The results of earlier research is presented. Radio has a big cost advantage over television and may be equally effective.

Herman W. Land Associates. THE HIDDEN MEDIUM: A Status Report on Educational Radio in the U. S. New York: National Educational Radio, April 1967.

This is a major study of educational radio facilities and programming conducted in the mid-60's. Radio's potential has been limited by a lack of funds and staff. Typical stations are discussed, and network facilities, both live and tape, are encouraged.

Parker, Lorne A. ETN-SCA Program Handbook. Madison: University Extension, The University of Wisconsin, 1969, 33 pp.

This is a description of an educational extension program using Subsidiary Communications Authorization (SCA) radio along with a telephone talkback system. The operation of the system is described with its working procedures in this guide for system users.

Parker, Lorne A. SCA A New Medium. Madison: University Extension, The University of Wisconsin, 1969, 43 pp.

SCA channels can be used for educational programming, and several utilizations are discussed. Particular coverage is given to the "Educasting" system and to potential data transmission uses of SCA.

SOPHISTICATION INDEX

This index presents a listing of articles concerning Educational/Instructional Radio, in three levels of sophistication. These levels are defined as follows:

Level 1 - Introductory material.

Level 2 - Requires basic knowledge and awareness of terms.

Level 3 - Requires extensive background knowledge in the area, plus technical or analytic background (Usually of interest to the specialist).

Level 2

Forsythe, Richard O. Instructional Radio.

Herman W. Land Associates. The Hidden Medium: A Status Report on Educational Radio in the U. S.

Parker, Lorne A. ETN-SCA Program Handbook.

Parker, Lorne A. SCA A New Medium.

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III. EDUCATIONAL / INSTRUCTIONAL RADIO

IV. TELEPHONE INSTRUCTION

A. DESCRIPTION

Telephone instruction permits a student to receive instructional programming or to engage in interactive drill at home using an ordinary telephone receiver (although some interactive systems may require Touch-Tone capability). Although the use of the telephone to bring the classroom to the invalid student is a familiar educational application of telecommunications, new uses for the telephone have been developed to supplement the classroom experience for non-invalids at extremely low cost.

A key experiment involving telephone instruction is the "Dial-a-Drill" system in New York City. This system's individually tailored mathematics drills can be conducted through a computer, with the Touch-Tone key-boards used for response. Another experiment now underway consists of providing random-access information retrieval material to students at home through the ordinary telephone network.

Telephone Instruction is quite closely related to a number of other areas, including Educational/Instructional Radio, Dial-Access, and Computer Augmented Instruction. The telephone system is particularly useful as a talkback device for use with instructional radio. The primary advantage of connection between dial-access and computer instruction facilities and the telephone system is that instructional materials may be obtained and used at any time and place, as evidenced by the study done on A Telephone Access Biomedical Information Center.

B. REVIEW

Very little published material pertaining specifically to telephone instruction has been discovered. A number of references to or possible uses of telephone instruction can be found in other Sections of this Literature Review relating to Educational/Instructional Radio, Dial-Access, Information Networks, and Computer Augmented Instruction.

A prime experimenter in the field is Bell Telephone Laboratories. Campbell and Honnold's Bell Laboratories Record article describes two experiments and techniques used in telephone instruction.

Dei Rossi, et.al., in A Telephone Access Biomedical Information Center describe a proposed network for medical personnel using voice grade lines to receive continuing education type materials. WATS lines can also be used to permit nationwide capability for the system.

REFERENCES

Campbell, R.R., and Honnold, G.H. Teaching by Telephone Bell Laboratories Record. January, 1970, pp. 23-25.

"Dial-a-Drill" and a random access information retrieval system are described. Telephone Instruction has a number of supplemental education uses, with the advantage of very low cost.

Dei Rossi, J.A., Lindholm, C.R., Mills, G.F., and Sumner, G.C. A Telephone Access Biomedical Information Center. Santa Monica, California: Rand Corporation. April, 1970, pp. 56.

Information centers for physicians using voice grade lines are proposed. Use of WATS lines can reduce cost to enable use of national centers. Cost can be reduced to about $1.00 per call.

SOPHISTICATION INDEX

This index presents a listing of articles concerning Telephone Instruction, in three levels of sophistication. These levels are defined as follows:

Level 1 - Introductory material.

Level 2 - Requires basic knowledge and awareness of terms.

Level 3 - Requires extensive background knowledge in the area, plus technical or analytic background (usually of interest to the specialist).

Level 2

Campbell, R. R. and Hannold, G. H. Teaching by Telephone.

Dei Rossi, J. A., Lindholm, C. R., Mills, G. F., and Sumner, G. C. A Telephone Access Biomedical Information Center.

AUTHORS' INDEX

IV. TELEPHONE INSTRUCTION

V. DIAL ACCESS INFORMATION RETRIEVAL SYSTEM

A. DESCRIPTION

Through the use of dial access information retrieval systems, a student at a remote location can use stored tape or film information. The user obtains the desired program by dialing a coded number and making a connection to the switching center where the programs are distributed. Dial access programs may be used for supplemental lessons, to permit a student to audit a missed lecture (or to review one), or to engage in some kind of instructional drill.

The capabilities of dial access systems vary greatly, depending upon the sophistication of the equipment. The simplest system permits a student to select a specific audio program (heard through headphones). If another student has at that time selected the same program (or one of the other programs that may be on the same multi-track tape), it is necessary to wait, or join the program in the middle. More sophisticated systems utilized "buffers", individual recorders for each study station. These buffers copy the original program at high speed, resulting in a true random-access system. These systems may also allow the student to control the tape direction, going back over difficult material, and to record his own reaction on the tape as well. Similar sophistication, at a much higher price, may be available for systems that utilize video although highspeed video "buffer" systems are under development. With the addition of a Touch-Tone dial, dial access stations may be used for computer-assisted instruction.

As a result of developments in earlier language laboratories, dial access techniques have been perfected through which the system can be customized to meet the needs and budget of school. When integrated into information network systems, dial access stations can provide a total information center easily accessable to the student whenever he wants to use it. Some new developments make it conceivable that the telephone can be used as a remote station in dial access systems, providing almost universal access to information.

B. REVIEW

Much of the interest in dial access systems involves the study and examination of existing and planned systems. Gabriel Ofiesh, in a study for the Office of Education, Dial Access Information Retrieval Systems: Guidelines Handbook for Educators, surveys the area, as of 1968, and describes the various alternative systems commercially available.

Rudy Bretz's description of the University of Texas Dental Branch Independent-Access Television System details a highly sophisticated system. Of interest here is the degree to which the system can be designed to meet the specialized needs of a particular disciplinary area.

Discussions of the current state-of-the-art along with some discussion of the utilization of dial access, can be found in Richard Hull's Dial Access Information Retrieval Systems and in Ira Singer's At Will and at Once: The Audio-Video Dial Access Information Retrieval System.

Both Potter, in Dial-Remote Resources, and North, in "Dial Access" as an Instructional Medium, deal with dial access systems from an educational criteria point of view.

As previously noted, dial access systems are closely related to Telephone Instruction and to Computer Augmented Learning and appropriate references may be found under these categories. Information about material programmed for use in dial access systems may be obtained in Instructional Television and Educational/Instructional Radio sections.

REFERENCES

Bretz, Rudy. The University of Texas Dental Branch Independent Access Television System. Santa Monica, California: Rand Corporation, February, 1970, 18 pp.

This document describes a very advanced electronic instructional system. Designed for dental laboratory courses, the system will include 100 student stations, each equipped with three-dimensional video, both motion and still. Instruction may be in multiple-track or branching formats, and the system records the students' responses.

Dei Rossi, J.A., Lindholm, C.R., Mills, G.F. and Sumner, G.C. A Telephone Access Biomedical Information Center. Santa Monica, California: Rand Corporation, April 1970, 56 pp. Prepared for the National Library of Medicine.

This document presents a combination of telephone and dial access techniques to provide information centers on a nationwide or regional basis for physicians.

Hull, Richard B. Dial Access Information Retrieval Systems. In Tickton, S.G. (Ed.). To Improve Learning. pp. 277-282.

The theory of dial access information retrieval systems is discussed and typical installations and alternatives are described. Some criticisms are offered on both the current state-of-the-art and the role of suppliers.

North, R. Stafford. "Dial Access" as an Instructional Medium. In Tickton, S.G. (Ed.). To Improve Learning. pp. 313-322.

Experience has been gained at Oklahoma Christian College. Dial access allows new methods of instruction, and vastly increases access to resources. The Oak Park and River Forest High School (Illinois) system is also discussed. Various capabilities are suggested.

Ofiesh, Gabriel D. Dial Access Information Retrieval Systems: Guidelines Handbook for Educators. Final Report. Office of Education, July 1968, 152 pp.

A survey of the status of dial access systems is presented. The emphasis has been placed on educational utilization. Design, equipment, and costs have been considered, and list of hardware and software suppliers is provided and hardware specifications are compared. Existing and planned systems (as of 1968) are listed.

Potter, George. Dial-Remote Resources. In Weisgerber, R.A. (ed.). Instructional Process and Media Innovation. pp. 390-403.

The educational advantages and disadvantages of dial access systems are noted. A case study of a system from planning and development through operation at Grand Valley State College is described.

Singer, Ira J. At Will and at Once: The Audio-Video Dial Access Information Retrieval System. In Tickton, S.G. (Ed.). To Improve Learning. pp. 339-352.

Dial access experience in West Hartford, Connecticut is presented. The rationale for various types of systems is presented along with some general cost figures. Teacher attitudes are mentioned.

SOPHISTICATION INDEX

This index presents a listing of articles concerning Dial Access Information Retrieval System, in three levels of sophistication. These levels are defined as follows:

Level 1 - Introductory material.

Level 2 - Requires basic knowledge and awareness of terms.

Level 3 - Requires extensive background knowledge in the area, plus technical or analytic background (usually of interest to the specialist).

Level 2

Bretz, Rudy. The University of Texas Dental Branch Independent Access Television System.

Hull, Robert B. Dial Access Information Retrieval Systems.

North, R. Stafford. "Dial Access" As an Instructional Medium.

Ofiesh, Gabriel D. Dial Access Information Retrieval Systems: Guidelines Handbook for Educators.

Potter, George. Dial-Remote Resources.

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Level 3

Dei Rossi, J. A., Lindholm, C. R., Mills, G. F., and Sumner, G. C. A Telephone Access Biomedical Information Center.

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V. DIAL ACCESS INFORMATION RETRIEVAL SYSTEM

VI. INFORMATION NETWORK SYSTEMS

A. DESCRIPTION

Information Network Systems provide for the transmission of audio, video, or digital material permitting efficient and rapid utilization of information resources. They are similar to library network systems which interconnect libraries allowing them to combine resources. Such information networks have been suggested for a variety of administrative and academic educational applicationa.

Ideally, a full information network would make any single item of information immediately available to anyone, regardless of location. It would also have transmission services flexible enough to transmit any type of information inexpensively and rapidly and would be supplied with appropriate input/output devices to permit the use of hard-copy/facsimile, soft-copy/still-video, or computer data exchange.

A significant factor in information network planning is the relationship between cost and/or signal quality and distance, bandwidth, and time. Since distance generally must remain fixed, the practical trade-off exists between bandwidth and time. The wider the bandwidth (the number of frequencies in the channel), the shorter the time required to transmit an equivalent amount of information. The quality (resolution) of the transmission (particularly important for facsimile or video) is a function of both bandwidth and time; as either is increased so is the quality. However, increased bandwidth and/or increased time also means increased cost. Thus, the objective is to plan an information network system that will provide the necessary services and quality most economically. For example, if a permanent leased-line is used rather than a dial-up line, time becomes less of a cost factor, and a time

sacrifice can be made to obtain the savings of a narrower bandwidth. For video, however, time is a constant (30 frames per second) and bandwidth is the only possible variable.

Information network systems may provide for a one-way distribution of data, but they should allow a two-way interchange of ideas and information. Switching systems can provide for access to more than one center of information.

Information network systems have many uses other than library/information retrieval. Remote data processing, computer services, and computer assisted instruction are among these uses. Students at a distance can make use of a university's resources, including its faculty, through information network techniques.

Although costs are quite high today because of common carrier tariffs, the advent of lower cost communications satellites will make full scale information networks more economically feasible on a national and international basis.

B. REVIEW

Perhaps the most significant recent event involving Information Network Systems was the Conference on Interlibrary Communications and Information Networks held at Airlie House in Warrenton, Virginia, on September 28 - October 2, 1970, sponsored by the Office of Education and the American Library Association. The Conference, chaired by Joseph Becker, considered cost, technological, social, and legislative/legal/political implications of the growing use of information network systems. A considerable number of planning questions were also discussed.

An important earlier conference relating to information network systems was the EDUNET study for the Interuniversity Communications Council conducted by Brown, Miller, and Keenan. This month-long conference brought together a large number of experts to propose detailed plans for video and data network systems linking the entire country. A specific timetable and financial schedule was proposed. The EDUNET proposal laid the groundwork for many of the proposals subsequently made at the Interlibrary Network Conference.

Joseph Becker, in his Telecommunications Primer, provides an introduction to the technology of information systems. A similar article by Frank Norwood, Telecommunications Programs Affecting Network Development, discusses the latest innovations in telecommunications technology (as of the Summer of 1970).

More detailed reviews of information networks are given in Becker and Olsen's article in Volume 3 of the Annual Review of Information Science and Technology or Carl Overhage's updated article in Volume 4.

Model library or information network systems have been proposed by Becker and Hayes (A Proposed Library Network for Washington State) and Joseph Licklider (A Hypothetical Blueprint for a National Information Network).

The first two papers in the Interlibrary Network Conference collection by Raymond C. Swank (Interlibrary Cooperation, Interlibrary Communications and Information Networks - Explanation and Definition) and John W. Bystrom (Interlibrary Communications and Networks - Needs and Issues) contain extensive discussions on the nature of information networks and their operation.

There are significant legal problems (particularly those of copyright) involved in the establishment of information network systems. Copyright - The Obstacles and Conflicts by Morton Bachrach discusses the legal status of the copyright problem, applying it particularly to CATV. Harold Hacker discusses some of the political problems encountered by networks in Jurisdictional Considerations in the Design of Library Networks.

The Industrial Electronics Division of the Electronic Industries Association published a statement, The Future of Broadband Communications, discussing possible applications and technologies using very wide channels. John Sodolski's Broad Bandwidth Telecommunications Systems is an extension of this work. By contrast, Kessler discusses the use of Narrow Band Telecommunications systems.

A number of the papers coming out of the Interlibrary Network Conference dealt with specialized communications networks, such as Ruth Davis' National Bio[illegible]ical Network. A related report, Alternative Technologies [illegible]r Information Networks by Farquhar and Dei Rossi of the Rand Corporation, also discusses medical information networks.

A report prepared by the Committee on Telecommunications of the National Academy of Engineering for the Department of Housing and Urban Development discusses possible applications of information network systems to urban problems. Of particular interest is a proposal for a Community Information Center.

One of the few documents on facsimile transmission exclusively is H. G. Morehouse's Equipment for a Facsimile Transmission Between Libraries; A description and comparative evaluation of these systems. He discusses the needs of facsimile and compares several alternative systems based on experience

gained in actual operation. Other articles that discuss terminal equipment in detail are Kessler's Narrow Band Telecommunications and Meaney's Implications of a Mixed Media Network for Information Interchange.

The Interlibrary Network Conference report contains many articles that compare transmission systems with cost, utilization, switching, and transmission factors. These articles, along with a few theoretical Rand Corporation reports, can be found in the Reference listings in this section.

Because of the broad scope of information network systems, additional information or similar technology may be found in reviews of instructional television (particularly CATV)(Section II and IIA), telephone instruction (Section IV), computer augmented learning (Section IX), and most importantly, in dial-access (Section V).

REFERENCES

Bachrach, M. Copyright - The Obsticles and Conflicts. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks, Airlie House, Warrenton, Virginia, September 28 - October 2, 1970. Chicago: American Library Association, 1971, 36 pages.

Legal problems of Information Networks and CATV carriage of copyrighted programs are discussed, and possible legislative implications are covered.

Becker, J. (Chm.) Conference on Interlibrary Communications and Information Networks, Airlie House, Warrenton, Virginia, September 28 - October 2, 1970. Chicago: Americal Library Association, 1971 (Working Draft).

This document consists of working papers from this major conference. All important aspects of interlibrary networks are considered.

Becker, J. Telecommunications Primer. Journal of Library Automation, Vol. 2/3. September 1969. pp. 148-156

This paper is a description of telecommunication devices including capacities, types of signals, and carriers. Although oriented towards interlibrary communications, it is a valuable introduction to information network system technology.

Becker, J., & Hayes, R. M. A proposed Library Network for Washington State. (Working Paper for the Washington State Library) September 1967. 50 pages.

An information network on a regional basis is proposed in detail. Costs, schedules, equipment, and switching are discussed, and the planning to meet anticipated utilization is emphasized.

Becker, J., & Olsen, W. C. Information Networks. In Cuadra, C. (ed.), Annual Review of Information Science and Technology, Vol. 3. Chicago: Britannica. 1968. pp. 289-387.

This is a major review of information network systems, and it includes a literature review covering 1967. Some uses of networks are discussed, and minimum capability standards are suggested.

Brown, G. W., Miller, J. G., & Keenan, T. A. EDUNET: Report of the Summer Study on Information Networks Conducted by the Interuniversity Communications Council. New York: John Wiley & Sons, Inc., 1967, 440 pages.

This highly significant research project proposes a nationwide information network system. Specific details of the system, including routing, line specifications, and costs, are discussed. Some possible uses of systems are described, as are organizational details.

Blackwell, F. W., Boehm, B. W., Chalfant, A., Farquhar, J. A., Markowitz, B., Root, H. G., & Rosenthal, A. H. Educational Information System Design. Santa Monica, Calif.: Rand Corporation. August 1970. 17 pages.

Some critical aspects in the design of an educational information system are treated. This paper cites 15 key operational system and information system decisions that must be made, indicates the implications of these decisions, and provides a framework for rational decision-making.

Brong, G. R. The Path to Interlibrary Networking for Audio Visual Materials. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 36 pages.

Library networks can be used to distribute non-print materials. Input/output and transmission techniques are discussed. Materials can be supplied to schools from a central source.

Bystrom, J. W. Interlibrary Communications and Networks--Needs and Issues. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 80 pages.

Information networks and the development of telecommunications networking by libraries are discussed. Application, social, political, and technological problems are covered and an extensive bibliography and literature review is included.

Coleman, J. S., & Karweit, N. L. Multi-Level Information Systems in Education. Santa Monica, Calif.: Rand Corporation. June 1970. 110 pages.

This is a detailed discussion of the types of data that could be handled by information systems. Computerized administrative data is particularly adaptable to use in network situations.

Davis, R. M. National Biomedical Network. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 61 pages.

Based on experience with a medical network, a general information network for specialized information is proposed. Its relevant cost, technology, and special-interest population factors are considered.

Dittberner, D. L. Telecommunications Equipment and Costs. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 13 pages.

The distance, bandwidth, and time relationship as applied to information network systems is discussed from a cost analysis basis. Improved digital techniques should lower costs for most forms of transmission.

Dunn, D. A. Principles of Telecommunications Planning. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 31 pages.

Planning requires selection of appropriate alternatives. Exact prediction of utilization is not possible, but a systematic decision-making procedure can be developed.

Electronic Industries Association. The Future of Broadband Communications. IED/EIA response to the Federal Communications Commission Docket 18397, Part V. Washington, D. C.: Industrial Electronics Division, Electronic Industries Association. October 29, 1969. 41 pages.

Broadband communications network systems permit transmission of large amounts of data. Types and standards of network systems are described with some technical detail.

Farquahar, J.A., & Dei Rossi, J. A. Alternative Technologies for Information Networks. Santa Monica, Calif.: Rand Corporation. December 1969. 9 pages.

Economic considerations inherent in designing user services that incorporate various communications systems are discussed. Utilization must be considered before implementation, that is, "The message must define the medium."

Hacker, H. Jurisdictional Considerations in the Design of Library Networks. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 79 pages.

This paper presents a description of the legal and political problems encountered in operating a New York State library network system.

Hayes, P. Financial Formulas for Library Networks. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 36 pages.

Formulas for the fiscal support of library networks are discussed against the framework of present patterns of library funding. Outside funds, probably from governmental sources, will be required.

Heinich, R. Social Consideration in the Design of Library Networks. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 30 pages.

Information networks will have major impact on structure of society. Preparation is required to ease the transition caused by rapid access to vast amounts of information. Instructional formats will be particularly affected.

Kessler, W. J. Narrow Band Telecommunications. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 37 pages.

Advantages of narrow bandwidth telecommunications and appropriate equipment are discussed. Emphasis is on graphics systems with future equipment projections included.

Kochen, M. Switching Centers for Inquiry Referral. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 27 pages.

Statistical analyses of response networks are presented. Trade-off between response time and quality of response is considered, and a review of related literature is included.

Licklider, J. C. R. A Hypothetical Blueprint for a National Information Network. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 31 Pages.

A possible information network plan is presented, based on library intersection with other knowledge centers. Technical considerations are included and a 1980 system model is presented. Developmental problems are discussed.

Meaney, J. W. Implications of a Mixed Media Network for Information Interchange. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 25 pages.

Information networks are likely to be required to handle many types of media. Coordination of interface equipment and transmission systems is essential. Main systems are likely to utilize video and data techniques.

Miller, R. Network Organization, A Case Study. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 32 pages.

Example is given of experience gained in Great Lakes region FAUL network. Organizational cooperation has been emphasized. Problems of coordination have also been faced.

Morehouse, H. G. Equipment for Facsimile Transmission Between Libraries; a Description and Comparative Evaluation of Three Systems. A Study Prepared for Council on Library Resources, Inc. Reno, Nevada: University of Nevada Library. December 20, 1967. 28 pages.

This is a description of tests conducted by a library using various types of telefacsimile equipment. Costs, quality, and reliability are discussed, and criteria for selection of appropriate equipment are proposed.

National Academy of Engineering. Broadband Cable Communications. In Communications Technology for Urban Improvement. Report to the Department of HUD. Appendix A. Washington, D.C.: Committee on Telecommunications, National Academy of Engineering, June 1971, pp. 195-206.

Possible urban uses of broadband communications network systems are described. Such systems can be used for education and municipal services.

Norwood, F. Telecommunications Programs Affecting Network Development. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 38 pages.

This review considers recent technological and political developments affecting telecommunications systems. The resulting potential is discussed using newly available techniques.

Overhage, C. F. J. Information Networks. In American Society for Information Science. Annual Review of Information Science and Technology, v. 4. Chicago: Encyclopedia Britannica, 1969. pp. 339-44.

The term "networks" is used in five different contexts: science literature, organization structures, cooperative arrangements, communications systems, and computer-communications systems. The first three, while important, do not specifically characterize the communications links to be used. This review then deals with the latter systems, which do specify the use of electric signal transmission.

Parker, E. B. Potential Interrelationships Between Library and Other Mass Media Systems. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 34 pages.

The role of libraries as storage and retrieval centers for information systems is considered. Storage media and form of distribution are of great importance and library-to-client transmission is of key concern.

Samuelson, K.A.H.W. Worldwide Information Networks. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 54 pages.

Automated information networks do not currently exist either nationally or internationally. The author examines what such networks should be, what are the differences among national, international, and worldwide networks, and how far-sighted planning can be provided in their design and development. He emphasizes the use of systems analysis techniques in policy making and early planning for global information networks.

Sodolski, J. Broad Bandwidth Telecommunications Systems. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 22 pages.

Broad bandwidth transmission, as exemplified by CATV, provides additional capacity to meet current transmission needs. Cable systems (CATV) and multiplexing arrangements are discussed.

Stevens, M. E. Compatability Problems of Network Interfacing. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 48 pages.

In the 1970's the formalizing of information exchange networks and the emergence of teleprocessing technology have created a new set of compatibility problems in information network technology. Compatibility problems at the machine-machine and man-machine interfaces are critical and urgent, but the man-man interface presents the most difficult problems. This article discusses in detail the problems and concludes that the "little that has been done to this time is only the earnest of what is yet to come."

Swank, R. C. Interlibrary Cooperation, Interlibrary Communications and Information Networks--Explanation and Definition. In Becker, J. (Chm.), Conference on Interlibrary Communications and Information Networks. 30 pages.

Principal issues of library network systems conference are discussed. Information network systems are defined as having information resources, readers or users, schemes for the intellectual organization of documents and data, methods for the delivery of resources to users, formal organizations of cooperating or contacting information agencies, and bidirectional communications facilities.

Weeg, Gerard P. The Role of Regional Computer Networks. In Levien, R. E. (Ed.). Computers in Instruction: Their Future for Higher Education. Santa Monica, Calif.: The Rand Corporation, pp. 55-66.

The future data-processing needs of U.S. colleges are discussed briefly. Advantages and disadvantages of various types of regional computer networks are outlined, including teletypewriter, batch processing and intelligent terminal networks, and interconnection of large computers.

SOPHISTICATION INDEX

This index presents a listing of articles concerning Information Network Systems, in three levels of sophistication. These levels are defined as follows:

Level 1 - Introductory material.

Level 2 - Requires basic knowledge and awareness of terms.

Level 3 - Requires extensive background knowledge in the area, plus technical or analytic background (usually of interest to the specialist).

Level 1

Davis, R. M. National Biomedical Network.

Norwood, F. Telecommunications Programs Affecting Network Development.

Level 2

Bachrach, M. Copyright - The Obstacles and Conflicts.

Becker, J. (Chm.) Conference on Interlibrary Communication and Information Networks, Airlie House, Warrenton, Virginia, September 28 - October 2, 1970.

Becker, J. Telecommunications Primer.

Becker, J., and Olsen, W. C. Information Networks.

Blackwell, F. W., Boehm, B. W., Chalfant, A., Farquhar, J. A., Markowitz, B., Root, H. G., and Rosenthal, A. H. Educational Information System Design.

Brong, G. R. The Path to Interlibrary Networking for Audio Visual Materials.

Brown, G. W., Miller, J. G., and Keenan, T. A. EDUNET: Report of the Summer Study on Information Networks Conducted by the Interuniversity Communications Council.

Bystrom, J. W. Interlibrary Communications and Networks - Needs and Issues.

Electronic Industries Association. The Future of Broadband Communications.

Heinich, R. Social Consideration in the Design of Library Networks.

Kessler, W. J. Narrow Band Telecommunications.

Licklider, J. C. R. A Hypothetical Blueprint for a National Information Network.

Miller, R. Network Organization, a Case Study.

Morehouse, H. G. Equipment for Facsimile Transmission Between Libraries: A Description and Comparative Evaluation of Three Systems.

National Academy of Engineering. Broadband Cable Communications.

National Academy of Engineering. Communications Project Recommendations.

Overhange, C. F. J. Information Networks.

Parker, E. B. Potential Interrelationships Between Library and Other Mass Media Systems.

Samuelson, J. A. and Becker, J. (Chm). World-Wide Information Networks.

Sodolski, J. Broad Bandwidth Telecommunications Systems.

Swank, R. C. Interlibrary Cooperation, Interlibrary Communications and Information Networks - Explanation and Definition.

Weeg, Gerald P. The Role of Regional Computer Networks.

Level 3

Becker, J. and Hayes, R. M. A Proposed Library Network for Washington State.

Coleman, J. S., and Karweit, N. L. Multi-Level Information Systems In Education.

Dittberner, D. L. Telecommunications Equipment and Costs.

Dunn, D. A. Principles of Telecommunications Planning.

Farquhar, J. A., and Dei Rossi, J. A. Alternative Technologies for Information Networks.

Hacker, H. Jurisdictional Considerations in the Design of Library Networks.

Hayes, P. Financial Formulas for Library Networks.

Kochen, M. Switching Centers for Inquiry Referral.

Meaney, J. W. Implications of a Mixed Media Network for Information Interchange.

Stevens, M. E. Compatability Problems of Network Interfacing.

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Coleman, J. S., and Karweit, N. L. Multi-Level Information Systems In Education.

Davis, R. M. National Biomedical Network.

Dei Rossi, J. A. and Farquhar, J. A. Alternative Technologies for Information Networks.

Dittberner, D. L. Telecommunications Equipment and Costs.

Dunn, D. A. Principles of Telecommunications Planning.

Electronic Industries Association. The Future of Br adband Communications.

Farquhar, J. A., Moskowitz, B., Root, H. G., Rosenthal, A. H., Blackwell, F. W., Boehm, B. W., and Chalfant, A. Educational Information System Design.

Farquhar, J. A., and Dei Rossi, J. A. Alternative Technologies for Information Networks.

Hacker, H. Jurisdictional Considerations in the Design of Library Networks.

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Hayes, R. M. and Becker, J. A Proposed Library Network for Washington State.

Heinich, R. Social Consideration in the Design of Library Networks.

Keenan, T. A., Brown, G. W., and Miller, J. G. EDUNET: Report of the Summer Study on Information Networks Conducted by the Interuniversity Communications Council.

Kessler, W. J. Narrow Band Telecommunications.

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National Academy of Engineering. Broadband Cable Communications.

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Norwood, F. Telecommunications Programs Affecting Network Development.

Olsen, W. C. and Becker, J. Information Networks.

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Parker, E. B. Potential Interrelationships Between Library and Other Mass Media Systems.

Root, H. G., Rosenthal, A. H., Blackwell, F. W., Boehm, B. W., Chalfant, A., Farquhar, J. A., and Markowitz, B. Educational Information System Design.

Rosenthal, A. H., Blackwell, F. W., Boehm, B. W., Chalfant, A., Farquhar, J. A., Markowitz, B., and Root, H. G. Educational Information System Design.

Samuelson, J. A. and Becker, J. (Chm). World-Wide Information Networks.

Sodolski, J. Broad Bandwidth Telecommunications Systems.

Stevens, M. E. Compatability Problems of Network Interfacing.

Swank, R. C. Interlibrary Cooperation, Interlibrary Communications and Information Networks - Explanation and Definition.

Weeg, Gerald P. The Role of Regional Computer Networks.

VII. COMMUNICATIONS SATELLITE SYSTEMS

A. DESCRIPTION

Communications satellites are earth-orbiting devices that repeat electromagnetic signals, such as audio and television, beamed at them from ground stations. In synchronous orbit (an orbit in which the motion of the satellite relative to the earth is essentially zero, and the satellite appears to stand still), three satellites can transmit signals to virtually anywhere on earth. In non-synchronous orbits more sophisticated ground equipment and additional satellites are required to achieve full coverage.

The major advantages of communications satellites over traditional land line communications systems are reduced cost of capital investment and reduced operational cost since with land lines the cost of signal transmission is partially a function of distance and area coverage.

At this time, communications satellites act as relay points for signal transmission. Programs originating in a TV studio go via common carrier satellite transmitter; the signal is transmitted to the satellite, retransmitted to a remote ground receiving station, transmitted by common carrier to conventional TV stations or CATV systems, and then to the receiver. As such, communications satellites must be considered as a part of the total communication system. This interrelationship introduces problems of technical compatibility, legislation, jurisdiction, and Federal regulation.

Another important technical consideration that has considerable impact on the application of communications satellites is the frequency allocation and bandwidth trade-offs.

International agreements concerning frequency and utilization allocations for communications satellites were recently concluded at the World Administrative Radio Conference (WARC) in Geneva (see Broadcasting, July 26, 1971, pp. 44-45). The conference agreed to the assignment of the 11,700-12,200 MHz band for domestic satellite space communications. It also allowed the U.S. to utilize the 6625-7125 MHz band for TV program distribution. The significance of frequency allocation decisions to education is emphasized by noting that this frequency allocation decision would allow construction of receiver-only earth stations at half or a third of the cost of those for higher frequencies. A significant provision of the conferences' assignments would have community services transmissions share the 2500 MHz band with ITFS, a move encouraged by the U.S. In a related decision, the FCC assigned three two-way channels to the Public Safety Services to meet the needs of county and municipal governments to provide specialized training for police and fire departments. These services will share the 2500 MHz band with ITFS transmissions.

B. REVIEW

The literature for satellite TV is scattered throughout different areas because of the communication systems interdependence as well as the large number of potential applications. For that reason, this literature review has considered communications satellites documentation from the viewpoint of technology, satellite education experiments, applications, educational requirements, and regulations.

The largest amount of information on technology is found in NASA publications, RAND reports, various technical conferences, and the submissions of the various companies to the FCC in their applications for permission to launch domestic communications satellites. (In the latter instance, these technical submissions are so closely related to the FCC policy review that additional literature information will be submitted with the FCC Docket report.)

A comprehensive review of the technology of telecommunications can be found in Staff Paper 1, Parts 1 and 2, of the President's Task Force on Communications Policy. More specific

projections of technology applicable to TV broadcast satellites are contained in the TRW Systems Group reports, by J. Jansen. In particular, The Television Broadcast Satellite Study Research and Technology Implication Report, relates to parametric cost data performance. Some of the detailed considerations involving the antenna design and the microwave components are described in the Stanford Center for Radar Astronomy report by Lusignan, Bulkeley, Janky, and Taggart.

Some of the other critical technical problems are within the Frequency Allocation area, such as those dealt with by WARC. The overcrowding of the spectrum makes it essential to select frequencies which will allow lower costs for the communications satellites while allowing for possible interference to existing transmission. Several studies have been made in this area by the Rand Corporation in reports by John Hult. Satellite Spacing and Frequency Sharing for Communication and Broadcast Services by Hult and Reinhart notes that satellites offer greater promise for area coverage to small terminals and then proceeds to propose the utilization of UHF as the proper frequency choice. Earlier articles by Hult, The Promise of UHF Satellites for Mobile, Broadcasts and Low Cost Services and Related New Communications Allocation, Operations and Policies, and Broadcast Opportunities with Satellites and CATV, and Their Control in the Public Interest, review frequency allocations from a sharing viewpoint.

A significant number of articles have been written about the application of satellites to education in underdeveloped countries. An analysis of the benefits to education is reviewed by Lawrence P. Grayson in Science. He discusses the problems of developing nations and the promise of satellites for numerous educational applications in "Education Beyond the Horizon: On Uses of Satellites for Education in Developing Nations." The high educational attrition rate is noted in the article Satellite Educational Television -- An Effective Form of Foreign Aid by Peter F. Sielman, who observes the positive benefits provided by educational television which shows that TV based instructional systems are specially effective for children of lower ability. In a follow-up article, Satellite Educational Television for the Underdeveloped Countries, Sielman reviews the technology of transmitting to a few central points or to an entire country or region.

A model for relating economic development in emerging countries to education is presented in Paul L. Jordan's Communications Satellites, Technology Transfer, and Economic Development.

Within this country, experiments have been carried out using the NASA-ATS satellites. Some early comments on the use of the ATS satellites are to be found in Jordan's article. More details on a Transcontinental Interconnection Experiment are found in the 1969 Corporation for Public Broadcasting proposal and the 1970 results of that experiment which demonstrated that high quality, reliable television transmission could be provided by satellite television on a routine basis.

Three additional satellite experiments the Alaska Educational Satellite Project, Proposed Far West Teacher Education Experiment on ATS-G and Pan Pacific Educational Satellite Network, are described by Harold E. Wigren utilizing the ATS-1 and ATS-G satellites. A joint evaluation mission by a member from UNESCO and the NEA report in Cassierer and Wigren's Alaska Implications of Satellite Communication for Educators, discuss the feasibility of using satellite communications in Alaska. Their conclusions are that this utilization is not only feasible but necessary.

On June 28, 1971, HEW announced the allocation of $702,000 to provide health and educational instruction by communications satellites to 21 isolated Alaskan villages (New York Times, June 29, 1971). Transmissions are planned for daily instructional lessons; lectures on nutrition, child development and snowmobile safety, and in-service training courses to teachers for college credit.

The relationship between telecommunications and education is broadly reviewed in the JCET Data Base and in Meany and Carpenter's Telecommunications: Towards National Policies for Education. More specific applications of TV to education on a national and international scale as it would be affected by satellites are contained in NEA's Television and World Understanding.

Lloyd Krause's Satellite Communications for U.S. Schools suggests various applications of satellite technology to education in a non-technical manner.

Since Cable Television programming will be significantly affected by satellite utilization, the interrelationship is important. Nathaniel Feldman in Cable Television and Satellites points out that through CATV, the cost of a satellite-receiving earth station can be spread out to between 500 and 2,500 subscribers to achieve greater cost efficiency.

Some additional applications of telecommunications to the urban problems are contained in H.S. Dordick's The New Communication Technology and For What?; the National Academy of Engineering (NAE) report to HUD; and Goldhamer's The Social Effects of Communications Technology. The NAE report shows the aspect of interactive educational systems. All three emphasize the role of satellites in the development of an effective telecommunication system.

The President's Task Force on Communications Technology Final Report and supporting papers contain material relevant to policy and utilization matters.

Several areas that were considered relative current applicable programs relating to communications satellites:

1. The current experiments for educational television in Alaska.

2. The various COMSAT communications satellite systems for international communications. COMSAT, which currently has extensive operating experience, has prepared various guides to Communications Satellite Technology for the non-technical reader.

3. The submissions by a number of U.S. companies to the FCC for permission to launch a domestic satellite system. These will be covered fully during the FCC Docket search.

The relationship between satellites and extensive communication networks can also be derived from materials indexed under Information Networks.

REFERENCES

Cassirer, H.R. & Wigren, H. Alaska: Implications of Satellite Communication for Education. Paris: UNESCO, Serial No. 2198/BMS.RD/MC, November 1970, 68 p.

The author reports a visit to Alaska to evaluate uses that ATS-1 satellites could be put to for educational purposes. Television transmission is not recommended until earth station cost can be significantly lowered. Radio experiments can be economically conducted. Various programs can be developed, relying originally on tape distribution networks.

Communications Satellite Corporation. Information Package. Washington, D.C.

This package is a collection of varied documents and reports relating to COMSAT's operational experience.

Corporation for Public Broadcasting. Comments of the Corporation for Public Broadcasting. Washington, D.C.: September 1969. 50 p.

This document argues that domestic satellite system should be open to general public interests and independent of common carrier rates and practices; that many agencies and groups should participate in the operations of the system; and that experimentation should continue in order to learn the most effective way of using satellite technology.

Corporation for Public Broadcasting. Transcontinental Interconnection Experiment. Washington, D.C.: November 1970. 17 p.

Reported is an experiment using the ATS-1 and ATS-3 satellites to test transmission quality using small (30-40 feet) receiving antennas. High quality video signals could be transmitted on a routine basis, even using the small antennas. New operational techniques were developed and are described.

Dordick, H.S. The New Communication Technology and For What? Rand Corp. Santa Monica, Calif. May 1968. pp. 22.

Future developments in mass communications are predicted. Emphasis is that future developments must be available at low cost-per-user. Satellites will help to make that possible regardless of distance involved.

Feldman, Nathaniel E. Cable Television and Satellites. Rand Corporation. August 1969. 10 p.

The combination of CATV and satellite technology is discussed. By adding the national resources offered by satellites to the vast capability of CATV systems, a communication system can be developed with a great amount of flexibility. This paper is a broad discussion of the potentials involved.

Goldhamer, Herbert (Ed.). Assisted by Westrum, Ronald. The Social Effects of Communications Technology. A report prepared for the Russell Sage Foundation, Santa Monica, Calif.: Rand Corp. May 1970. 31 p.

The effect of new communications systems on social systems is discussed in non-technical terms. The communications revolution requires further insight into social conditions and situations.

Grayson, Lawrence P. Education Beyond the Horizon: On Uses of Satellites for Education in Developing Nations. In Science. December 25, 1970, 29 p.

The author holds that satellites are especially useful for distributing educational materials and data to remote areas where resources are limited. Voices, video, and data channels can permit underdeveloped nations to utilize their trained personnel and limited finances most efficiently, reaching the greatest number of persons. On an international basis, worldwide data and information networks can promote understanding and common development. Planning is a critical to maximize effectiveness and minimize political problems.

Hult, John L. Broadcast Opportunities with Satellites and CATV, and Their Control in the Public Interest. Santa Monica, Calif.: The Rand Corp, March 1970. 8 p.

This paper explores the opportunities for providing new TV broadcast services and a variety of social benefits from broadcasting using satellites and CATV. The relative costs of the various alternatives are outlined, and new regulatory and operational policies are suggested. Outlines a wealth of novel opportunities available under the suggested new policies.

Hult, J.L. The Promise of UHF Satellites for Mobile, Broadcast, and Low-Cost Services and Related New Communications Allocations, Operation, and Policies. Rand Corp. May 1969. 46 p.

Sharing of satellite systems by a number of mobile services can increase versatility of communications system. UHF satellites can be used for low cost, portable installations.

Hult, J.L. and Reinhart, E.E. Satellite Spacing and Frequency Sharing for Communication and Broadcast Services. Rand Corp. December 1970. 38 p.

The author outlines a general approach for the efficient use of satellite orbits and the radio frequency spectrum. Solution of interference problems and efficient frequency assignment are critical to maximum use of satellites by many services.

Hult, J.L. Spectrum for Area Coverage from Satellite Relays to Small Terminals. Rand Corp. March 1970 10 p.

This report presents technical and spectrum factors involved in planning for small mobile and broadcast terminals. Frequencies can be shared by satellite and terrestial services provided precautions are taken.

Jansen, J. Television Broadcast Satellite Study Research and Technology Implications Report. Redondo Beach, Calif.: TRW Systems Group. January 1970. 14 p.

This report considers the major characteristics of three spacecraft configurations. Overall subsystem requirements for specific designs emphasize linearity and stability of high gain amplification, isolation between transmitter and receiver, and thermal isolation.

Jansen, J. and Jordan, P.L. Television Broadcast Satellite Study. Final Report. Redondo Beach, Calif.: TRW Systems Group. October 1969. 546 p.

This report discusses the various technical aspects relevant to development and design of television broadcast satellites and the user equipment for receiving satellite broadcasts. Three satellite configurations are outlined. Parametric cost data versus overall system performance are presented. Potential audiences are identified and benefits to education are discussed, and required development is identified.

Joint Council on Educational Telecommunications. Communications Satellites. JCET DATA BASE. No. 3. Washington, D.C. November 1968, 4 p.

This is a brief, comprehensive introduction to educational applications of satellites. Technical requirements and potential capabilities are discussed. Several alternative systems are explained.

Jordan, Paul L. Communications Satellites, Technology Transfer, and Economic Development. Santa Monica, California: The Rand Corp., June 1970, 12 p.

This report discusses satellite technology as used in developing countries, including the relationship between economic development, education, and the level of applied technology. Use of satellites for ITV requires dedication of resources.

Krause, Lloyd I. Satellite Communications for U.S. Schools. A Proposed Public Service Offering by Private Business. Washington, D.C.: MCI Lockheed Satellite Corp., February 1971, 16 p.

This is a summary of educational advantages to be derived from a domestic satellite system. Although prepared in support of a specific company's application, it does emphasize the low costs of satellite utilization on a broad scale. Existence of a satellite system will promote extensive use of television and computers in the schools.

Lusignan, B.B., Bulkeley, P.Z., Janky, J.M., and Taggart, R.B., Jr. The Design and Development of a Low-Cost Microwave Adaptor Suitable for Television Reception from High-Power Communications Satellites. Final Report. Stanford University of Calif.: Center for Radar Astronomy, October 1970, 196 p.

A novel low-cost design for the antenna and electronics is presented, which is estimated to cost $32 in quantities of 100,000 units. The electronics package is estimated to cost $60 for the same production quantity.

Meaney, John W. and Carpenter, C. Ray (Eds.). Telecommunications: Toward National Policies for Education. Washington, D.C.: Joint Council on Educational Telecommunications. 1969. 193 p.

This general report includes brief but inclusive reviews of possible impacts on education by technological developments. Satellite systems may have a vast impact on schools.

National Academy of Engineering. Communications Technology for Urban Improvement. Report to the Dept of Housing and Urban Development. Washington, D.C.: NAE Committee on Telecommunications. June 1971. 219 p.

The role of total telecommunications systems in urban situations is discussed. Emphasis is on future development to insure desired coverage of all services.

President's Task Force on Communications Policy. The Future of Intelsat; Satellite Communications and Educational Television in Less Developed Countries; and Domestic Applications of Communication Satellite Technology. In Final Report: President's Task Force on Communications Policy. Chapters 3-5. Washington, D.C.: December 7, 1968.

This document presents policy and planning considerations for national and international satellite systems. It discusses the role of satellites and ways to achieve goals. Educational needs are given high priority.

President's Task Force on Communications Policy. A Survey of Telecommunications Technology. Staff Paper 1, Parts 1 and 2. Washington, D.C.: June 1969.

This is a total overview of technology in telecommunications. All current and potential devices are discussed.

President's Task Force on Communications Policy. Satellite Communications Land Educational Television in Less Developed Countries. Staff Paper 3. Washington, D.C.: June 1969. 381 p.

This report illustrates multi-purpose facilities for Latin America with illustrative applications in India. It presents a general view of the prospects for satellite distributed educational television for developing countries.

Sielman, Peter F. Satellite Educational Television--An Effective Form of Foreign Aid. Deer Park, N.Y.: Airborne Instruments Laboratory. 13 p.

This paper considers the use of a stationary satellite to provide educational television for underdeveloped countries. A single satellite is proposed with transmission potential to several countries. The relationships between satellite bandwidth, coverage, and picture quality are analyzed and frequency transmission trade-offs are made. Based on these considerations and the limitations of frequency allocation agreements, practical satellite hardware and terminal cost estimates, and optimum ranges of the design parameters are established. Consideration is also given to the development of community television terminals and local rerouting.

Sielman, Peter F. Satellite Educational Television for Underdeveloped Countries. Deer Park, N.Y.: Airborne Instruments Laboratory, October 1968, 10 p.

This paper reviews the utilization of the satellite for the transmission and distribution of television from the viewpoint of redundancy, control and other related implimentation problems. The major portion of the paper looks at the problems associated with initiating satellite educational television for underdeveloped countries. A review of certain systems problems relating to satellite sharing and responsibility, satellite control and protection, heterogenity of languages and interaction between teacher and student is likewise reviewed.

Tyler, I. Keith. Television for World Understanding. Washington, D.C.: Division of Educational Technology. National Education Association. 1970, 80 p.

Television's impact on students and its role in educational process are discussed. This paper includes discussion of role played by commercials television as well as ETV and ITV, in forming values, etc. The author proposes programming goals designed to achieve a certain objective, international understanding.

Wigren, Harold E. Alaska Educational Satellite Project, Proposed Far West Teacher Education Experiment on ATS-G, and Pan Pacific Educational Satellite Network. Washington, D.C.: National Education Association. 10 p.

This report describes three educational satellites communications studies in Alaska, the Far West, and the Pan Pacific area. The goal is to use ATS series satellites to interconnect educators in sparcely populated regions. Emphasis is placed on point-to-point voice, two-way, and facsimile transmission.

SOPHISTICATION INDEX

This index presents a listing of articles concerning Communications Satellite Systems, in three levels of sophistication. These levels are defined as follows:

Level 1 - Introductory material.

Level 2 - Requires basic knowledge and awareness of terms.

Level 3 - Requires extensive background knowledge in the area, plus technical or analytic background (usually of interest to the specialist).

Level 2

Cassirer, H. R. and Wigren, H. Alaska: Implications of Satellite Communication for Education.

Communications Satellite Corporation. Information Package.

Corporation for Public Broadcasting. Comments of the Corporation for Public Broadcasting.

Dordick, H. S. The New Communication Technology and For What?

Feldman, Nathaniel E. Cable Television and Satellites.

Goldhamer, Herbert (Ed.) and Westrum, Ronald. The Social Effects of Communications Technology.

Grayson, Lawrence P. Education Beyond the Horizon: On Uses of Satellites for Education in Developing Nations.

Hult, John L. Broadcast Opportunities with Satellites and CATV, and Their Control in the Public Interest.

Joint Council on Educational Telecommunications. Communications Satellites.

Jordan, Paul L. Communications Satellites, Technology Transfer, and Economic Development.

Krause, Lloyd I. Satellite Communications for U. S. Schools. A Proposed Public Service Offering by Private Business.

Meaney, John W. and Carpenter, C. Ray (Eds.). Telecommunications: Toward National Policies for Education.

National Academy of Engineering. Communications Technology for Urban Improvement.

President's Task Force on Communications Policy. The Future of Intelsat; Satellite Communications and Educational Television in Less Developed Countries; and Domestic Applications of Communication Satellite Technology. Final Report. Chapters 3-5.

President's Task Force on Communications Policy. A Survey of Telecommunications Technology. Staff Paper 1, Parts 1 and 2.

President's Task Force on Communications Policy. Satellite Communications Land Educational Television in Less Developed Countries. Staff Paper 3.

Tyler, I. Keith. Television for World Understanding.

Level 3

Corporation for Public Broadcasting. Transcontinental Interconnection Experiment.

Hult, J. L. The Promise of UHF Satellites for Mobile, Broadcast, and Low-Cost Services and Related New Communications Allocations, Operation, and Policies.

Hult, J. L. and Reinhart, E. E. Satellite Spacing and Frequency Sharing for Communication and Broadcast Services.

Hult, J. L. Spectrum for Area Coverage from Satellite Relays to Small Terminals.

Jansen, J. Television Broadcast Satellite Study Research and Technology Implications Report.

Jansen, J. and Jordan, P. L. Television Broadcast Satellite Study.

Lusignan, B. B., Bulkeley, P. Z., Janky, J. M., and Taggart, R. B., Jr. The Design and Development of a Low-Cost Microwave Adaptor Suitable for Television Reception from High-Power Communications Satellites.

Sielman, Peter F. Satellite Educational Television--An Effective Form of Foreign Aid.

Sielman, Peter F. Satellite Educational Television for Underdeveloped Countries.

Wigren, Harold E. Alaska Educational Satellite Project, Proposed Far West Teacher Education Experiment on ATS-G, and Pan Pacific Educational Satellite Network.

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VII. COMMUNICATIONS SATELLITE SYSTEMS

Hult, John L. Broadcast Opportunities with Satellites and CATV, and Their Control in the Public Interest.

Hult, J. L. The Promise of UHF Satellites for Mobile, Broadcast, and Low-Cost Services and Related New Communications Allocations, Operation, and Policies.

Hult, J. L. and Reinhart, E. E. Satellite Spacing and Frequency Sharing for Communication and Broadcast Services.

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Janky, J. M., Taggart, R. G., Jr., Lusignan, B. B., and Bulkeley, P. Z. The Design and Development of a Low-Cost Microwave Adaptor Suitable for Television Reception from High-Power Communications Satellites.

Jansen, J. Television Broadcast Satellite Study Research and Technology Implications Report.

Jansen, J. and Jordan, P. L. Television Broadcast Satellite Study.

Joint Council on Educational Telecommunications. Communications Satellites.

Jordan, P. L. and Jansen, J. Television Broadcast Satellite Study.

Jordan, Paul L. Communications Satellites, Technology Transfer, and Economic Development.

Krause, Lloyd I. Satellite Communications for U. S. Schools. A Proposed Public Service Offering by Private Business.

Lusignan, B. B., Bulkeley, P. Z., Janky, J. M., and Taggart, R. B., Jr. The Design and Development of a Low-Cost Microwave Adaptor Suitable for Television Reception from High-Power Communications Satellites.

Meaney, John W. and Carpenter, C. Ray (Eds.). Telecommunications: Toward National Policies for Education.

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President's Task Force on Communications Policy. The Future of Intelsat; Satellite Communications and Educational Television In Less Developed Countries; and Domestic Applications of Communication Satellite Technology. Final Report. Chapters 3 - 5.

President's Task Force on Communications Policy. A Survey of Telecommunications Technology. Staff Paper 1, Parts 1 and 2.

President's Task Force on Communications Policy. Satellite Communications Land Educational Television in Less Developed Countries. Staff Paper 3.

Reinhart, E. E. and Hult, J. L. Satellite Spacing and Frequency Sharing for Communication and Broadcast Services.

Sielman, Peter F. Satellite Educational Television--An Effective Form of Foreign Aid.

Sielman, Peter F. Satellite Educational Television for Underdeveloped Countries.

Taggart, R. B., Jr., Lusignan, B. B., Bulkeley. P. Z. and Janky, J. M. The Design and Development of a Low-Cost Microwave Adaptor Suitable for Television Reception from High-Power Communications Satellites.

Tyler, I. Keith. Television for World Understanding.

Westrum, Ronald and Goldhamer, Herbert (Ed.). The Social Effects of Communications Technology.

Wigren, Harold E. Alaska Educational Satellite Project, Proposed Far West Teacher Education Experiment on ATS-G, and Pan Pacific Educational Satellite Network.

Wigren, H. and Cassirer, H. R. Alaska: Implications of Satellite Communication for Education.

VIII. COMMON CARRIER

A. DESCRIPTION

Communications common carriers transmit of communications signals and provide fixed rate services for "public hire" on a regulated basis. Interstate rates and terms of service, known as tariffs, are filed with and regulated by the Federal Communications Commission. Intrastate rates and local services are regulated by State Public Utilities Commissions (except in Texas where local authorities exercise regulatory authority).

The most important feature of the common carrier system is that it is a regulated monopoly. Each locality, for example, is served by only one telephone company, and all long-distance phone services are handled by a single national company, AT&T Long-Lines. Because there is no competition and because communications services must be financially secure, common carriers are guaranteed a fixed rate of return on investment (usually 6-7%) by law. Rates are set through a public hearing procedure to insure that the public interest is the prime consideration.

The two major domestic common carriers are AT&T, which provides voice, video, and private line services currently and plans to provide a digital network in the near future, and Western Union which provides a variety of message and private line services. Although both AT&T and Western Union have operated switched message services (TWX and Telex, respectively), Western Union has purchased AT&T's share of this service. Several smaller telephone companies (GT&E being the largest), provide additional services.

The tradition position of common carriers as regulated monoplies has recently been threatened by a number of new companies, who have filed applications to provide Specialized Common Carrier Service. Based on the FCC's favorable decision on the Microwave Communications, Inc., application to provide service between Chicago and St. Louis (FCC Docket 16509), national and regional specialized carrier systems have been proposed. As a result of the policies under development in FCC Docket 18920, it is likely

that specialized carriers will be permitted to offer significant competition to existing carriers, hopefully providing lower rates and increasingly flexible service tariffs. The two major specialized carrier applicants are the MCI Carriers, an association of locally owned companies affiliated with MCI, proposing voice and data private line services, and Data Transmission Co. (DATRAN), which has proposed a switched, all digital network designed for data users.

Most likely, the entry of new common carriers will result in lower rates and improved services to all users. Information network techniques for educational application will benefit greatly.

Other new technological developments with Common Carrier implication include Communications Satellites and CATV, both of which can be used to provide low cost, flexible Common Carrier services.

B. REVIEW

Outside the field of regulatory economics, little independent research has been done on communications common carriers. Western Union, AT&T and DATRAN are sources of technical data on the development of new transmission techniques, and the FCC has published several information bulletins on common carriers regulation. The most comprenhensive of the latter, Common Carrier Services (FCC Information Bulletin 12-C, June, 1971), describes the common carrier services available and potential developments.

The legislative and regulatory background of current communications issues, including common carriers, are described in a legally oriented paper by Stephen Perlman Legal Aspects of Selected Issues in Telecommunications. Relevant FCC Dockets (particulary Docket Nos. 16509 and 18920) also provide good descriptions of these issues.

Two books, Communications in the World of the Future by H. Hellman and Future Developments in Telecommunications by J. Martin, provide highly understandable discussions of the technical relationships existing between information transmission and information reception. The former book is introductory and useful for the telecommunications layman; the latter requires at least a cursory knowledge of telecommunications.

REFERENCES

Cole, Zylstra and Raywid, Attorneys at Law, A Video Common Carrier System in Florida. An application to the FCC. October, 1971. Video Microwave, Inc.

Twenty-eight locations in Florida plan to submit applications for the formation of a two-way switched video microwave system for transmission of common carrier video services. This is the initial application and it indicates provisions to interconnect the nine (9) educational stations in the region to each other and to the national public television network. For educational use, the company indicates that it is willing to treat its investment on an incremental basis so that it can provide quality service at minumum prices for educational television. It estimates that these prices can be as much as 30 per cent less than the reduced prices negotiated by the Public Broadcasting Service with the Bell System. The implication to education is that as specialized data transmission service becomes available, the cost to educational telecommunication will decrease thus encouraging the greater utilization of educational technology equipment.

Common Carrier Services, (FCC Information Bulletin 12-C, June, 1971).

This FCC report is an excellent historical and application-oriented history of common carrier services. It includes a chronological survey of the advent and current status of the regulatory laws, The application portion of the report describes the relationships between the common carriers and CATV and satellite communications, including both the global and domestic satellite systems. While the report does not address any direct aspects of educational telecommunications, the comprehensive overview of the entire common carrier capability within the U.S. does provide an indication of potential resources that could be brought to bear towards establishing a nationwide telecommunication network.

The Data Transmission Market of the 1970's. A major research study conducted by the Data Transmission Company. Copyright 1970.

This study was undertaken to survey the domestic data communications market through 1980 for seven selected economic segments. These segments represent a substantial portion of the domestic, civilian economy and probably an even greater portion of the nation's data communication market. The paper predicts, for example, a cumulative growth from 1970 of 1650% in transaction volume, and 1100% in data com-

munication termination points. Such an increase could result in sharply reduced equipment and common carrier costs which would be beneficial to educators.

Dittberner Associates. "Interconnection Action Recommendations". A report to the Common Carrier Bureau, FCC. Sept. 1, 1970.

This report describes the direct interconnection of customer-provided equipment with the common-carrier. The report recommends that such interconnection be permitted as long as the customer-provided equipment meets the standards for network protection capability that were developed by the common carrier and approved by the FCC, and as long as the equipment is installed and maintained by a FCC certified installation / maintenance organization or individual contractor. These recommendations have significant educational implications in that the educational community would be able to purchase educational technology equipment for direct connection to the common carriers. This should encourage companies to develop peripheral equipment for the educational community.

Hellman, Hal. Communications in the World of the Future. New York: M. Evans and Company, Inc., 1969, 201 p.

This introductory book, written for the layman, describes the technical relationships that exist among the information source, the transmission of information, the reception of information. It offers the educational community an opportunity for a technical understanding of a communication system and thus an understanding of the role of a particular piece of educational technology equipment in the entire telecommunication system. The book also predicts some future application of communication systems and equipment and thus allows the educator to extrapolate these applications to education.

Littlechild, S. C. Peak-Lead Pricing of Telephone Calls. The Bell Journal of Economics and Management Science, New York. Autum 1970, pp. 191-210.

Planning for improving the efficiency with which resources are used in the communication industry depends upon bringing the cost of services into line with marginal costs. This paper develops a mathematical programming model to determine optional prices in this network structure. This article is a sophisticated analysis of the technical and economic aspects of telephone common carriers as they relate to cost. Since the future utilization of educational telecommunication equipment will be directly related to common carrier costs, the mathematical approach to this subject should provide the educator with a detailed and comprehensive insight into this area.

Martin, J. Future Developments in Telecommunication. Prentice Hall, Inc. Englewood Cliffs, New Jersey: 1971, 413 p.

This book presents a technical review of techniques used for telecommunication transmission and the relationship of this transmission to the originator and receiver. It outlines the techniques utilized for processing switching networks and digital transmission. Although the contents are not of high technical or mathematical nature, the reader should have some knowledge of telecommunications and be familiar with the terms and general concepts.

Perlman, Stephen B. Legal Aspects of Selected Issues in Telecommunications. AFIPS Press, Montvale, N. J.. December 1, 1970, 143 p. B.-290

This report originally produced for the National Science Foundation, identifies and assesses some of the pervasive influences of the newed inter- and mass-communications developments. It also treats the discernable national communication policy emanating from the current increasingly differentiated consumer demand that is causing the once-distinct segments of the industry to blur and frequently overlap. This report is of additional significance since it provides an excellent appended set of footnotes of the legal and regulatory aspects in telecommunications. This broad range of references, most of which relate to common carriers, will provide the educator with sources of specialized information. For example, adequate references for copyright problems would be of particular significance to the educator in his need for displaying and utilizing information. The footnotes also provide good reference to the interrelationship between common carrier regulations and other connecting portions of telecommunications systems.

President's Task Force on Communication Policy. Final Report. Chapter Six. The Domestic Telecommunications Carrier Industry, Washington, U.S. Government Printing Office. December, 1968. 62 p.

This report concludes that the basic structural element of domestic telecommunication services - the integrated provision of public message telephone service - is satisfactory; and the case for private monopoly regulated by public authority is convincing. As a twin conclusion, the report recommends releasing and encouraging potentialities for improvement which might otherwise be restrained by tradition or regulatory practice. In this latter regard, more liberalized entry into private line service is considered a salutary competitive pressure resulting in new kinds of services offering a wide range of quality, capacity, and price levels to varying needs of particular user groups. The implication

to the educational community of the new specialized microwave service would be lower cost and greater availibility for educational telecommunications whose inherent price reduction would enhance the utilization of educational technology equipment.

Reagan, Jr., Fonnie H. A Manager's Guide to Phone and Data Sources, Computer Decision, October, 1971. 4p.

This article is a survey of common carrier facilities with guidelines for their best selection according to the individual requirements. The various types of communication facilities are classified according to two criteria: speed and system arrangement. The public telephone network, wide area telephone service (WATS) and leased voice-band lines are considered and evaluated from an economic and utilization viewpoint. The article notes that WATS is seldom justified for data communications unless the user has access to an existing trunk with unused time available. Between leased lines and direct distance dialing (public telephone network), the pertinent factors are the distances to each communication point, the degree of loading, and the time of day when the communications are made. This article provides the educator with a functional and economic insight as to maximizing the utilization of common carriers.

The Revolution in the Phone Business, Business Week, November 6, 1971, 7 p.

This article contains projections of future telecommunication systems that interconnect with the common carriers and the related projected impact of each system on the common carrier. Predictions note that the communication plant investment is growing so rapidly that by 1980, the annual rate of investment could equal the total value of plant now in place - over $40 billion a year. Additionally, the massive wiring project that will bring CATV to the cities may require an investment of another $30 billion to $50 billion in the next nine years. This investment will provide and result in a growth market for new products and services. The article should provide the educator with an insight into the very large projected growth of telecommunications and their inherent implications to education through both increased facilities and reduced costs, stemming from specialized service.

SOPHISTICATION INDEX

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Level 2 - Requires basic knowledge and awareness of terms.

Level 3 - Requires extensive background knowledge in the area, plus technical or analytic background (usually of interest to the specialist).

Level 1

Business Week. The Revolution in the Phone Business.

FCC Information Bulletin 12-C. Common Carrier Services.

Hellman, Hal. Communications in the World of the Future.

Level 2

Cole, Zylstra and Raywid, Attorneys at Law. A Video Common Carrier System in Florida.

Martin, J. Future Developments in Telecommunication.

President's Task Force on Communication Policy. Final Report. Chapter Six. The Domestic Telecommunications Carrier Industry.

Reagan, Fonnie H., Jr. A Manager's Guide to Phone and Data Sources.

Level 3

Data Transmission Company. The Data Transmission Market of the 1970's.

Dittberner Associates. "Interconnection Action Recommendations."

Littlechild, S. C. Peak-Lead Pricing of Telephone Calls.

Perlman, Stephen B. Legal Aspects of Selected Issues in Telecommunications.

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VIII. COMMON CARRIER

Business Week. The Revolution in the Phone Business.

Cole, Zylstra and Raywid, Attorneys at Law. A Video Common Carrier System in Florida.

Data Transmission Company. The Data Transmission Market of the 1970's.

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Perlman, Stephen B. Legal Aspects of Selected Issues in Telecommunications.

President's Task Force on Communication Policy. Final Report. Chapter Six. The Domestic Telecommunications Carrier Industry.

Raywid, Cole, and Zylstra, Attorneys at Law. A Video Common Carrier System in Florida.

Reagan, Fonnie H., Jr. A Manager's Guide to Phone and Data Sources.

Zylstra, Raywid, and Cole, Attorneys at Law. A Video Common Carrier System in Florida.

IX. COMPUTER AUGMENTED LEARNING

A. DESCRIPTION

Computer Augmented Learning (CAL) is the currently popular term used to describe the broad field of instruction in which a computer is used on a time-shared basis with several terminals to perform an instructional function, or to allow a student to retrieve information of many kinds. Some of the educational functions that may be performed by CAL are: presenting material and problems; guiding students through a course by answering questions, varying answers according to student's level, speed of response, previous areas of expertise, etc.; assessing student performance; maintaining records of student performance; and individually prescribing sets of materials according to mastery of subject matter, need for remediation, etc.

In addition to the above tasks, the methods in which they may be performed may be varied. They may vary from a very structured, single-track, machine-directed program, similar to reading a book page by page, to a student-directed retrieval of information where the student requests are limited only by the total information available to the computer memory. Other forms of student-directed activity with the computer include: experimentation and discovery, as in some science lab courses; simulation and gaming; model building; and diagnosis of both medical problems from presenting symptoms, and electronic parts malfunction within an operating electronic system.

Other terms applied to this field are Computer Assisted Instruction (CAI), Computer Administered Instruction (CAI) Computer Assisted Learning (CAL), Computer Aided Teaching (CAT),

Computer Aided Instruction (CAI). Some authors make slight distinctions and propose one term over the other, but they all use the computer as a central storage and processing unit.

Computer Managed Instruction, however, does relate to a more complex function in which correction, guidance, assignments, outside reading, and direction are supplied in accordance with the individual user's progress so that a student may be branched into remedial loops for parts of the program not mastered on the first round, or, in other cases, jumped over large segments of material with which he is already familiar. Such systems may be made to appear to be infinitely patient. They may record a student's progress and even assign a grade at the end of a program of instruction.

In this study we will not attempt to make a sharp distinction between Learning Labs and CAL. It should be obvious that a Learning Lab may represent the input-output (I/O) section of a CAL system, or in the case of a Language laboratory, no computer at all may be used. The prime concern of this study -- telecommunications -- therefore leads us to exclude systems where remote terminals cannot be connected to the system. A listing below under section 4: Other Subjects lists both learning lab and CAL applications for language learning.

Learning laboratories were first developed as a group of student carrels in which students could work individually with a teaching machine or tape recorder. In most cases these were started as language laboratories to allow students to listen to and, in many cases, speak back to a teacher at a central console, as well as listen to tapes and record their own attempts to mimick the sounds heard, for comparison with the original. Today these labs allow for dial access to many different programs, and some provide for video, 8 mm film, and film strips to be combined with the audio channels in various combinations.

As these systems combine more media, including facsimile and hard copy, they are sometimes referred to as electronic classrooms rather than learning labs.

With the connection of dial access to learning labs, it has become possible for a college student to get the learning lab audio information at home or in a dormitory by way of telephone lines. With the advent of cable TV, the same possibilities for remote access will exist with video combined with

audio. By using a touch tone system, rather than dial access, an interactive system is possible combining information retrieval, C.A.L., audio visual instruction, etc. Thus, it appears that with the advent of cable and satellite communications systems all the features of C.A.L., learning labs, etc., will be available to persons at school, at home, or through community learning centers.

B. REVIEW

A good introduction to Computer Augmented Learning (CAL) in laymen's language is contained in Computers: New Era for Education?. Other reviews by: Hansen, D.N. Current Research Development in Computer Assisted Instruction; Levien, R.E. The Emerging Technology: Instructional Uses of the Computer in Higher Education; Feingold, S.L. CAI Systems Past, Present and Future; and Thornton, J.W. Jr. New Media and College Teaching; give more sophisticated reviews of the literature. Grayson's, article in Engineering Education and Grayson and Robinson's, Guide to Information Sources to be published by U.S. Govt. printing office give reference to other major reviews.

1. C.A.L. General Coverage of the field may be found in the following publications:

Computers: New Era for Education? National School Public Relations Assoc. Washington, D.C.: 1968, 24 p. B.-25.

This is an overview for the general reader of some present and future uses of the computer in education. Included are: descriptions of CAI at several grade levels; different subject matter where CAI is used; implications of CAI, which appear to indicate that widespread use of CAI will come about through further education of teachers and administrators as to the computer's capabilities, etc.

Feingold, Samuel L. CAI Systems Past, Present, and Future. Washington, D.C.: System Development Corporation, February 11, 1970, 9 p.

In looking back at the development of CAI systems at System Development Corporation over the past eleven years, one can see a pattern of interaction between advances in computer hardware and software and continuing efforts to solve the basic problems of CAI--problems of keeping the cost low, making coding and editing easier, achieving a natural-language capability--that existed from the beginning. As new equipment and higher-level languages became available, solutions to one or another of these basic problems became feasible. Now, in the fourth "generation" of CAI, we have on-line time-sharing capabilities, and a flexible language that embodies both program logic and instructional content. This pattern gives some hint of how things will proceed into the future.

Grayson, Lawrence P. An Introductory Guide for Engineering Teachers on Uses of Computers in Instruction. In Engineering Education, March, 1970, 8 p. B-.28.

This is a section of the author's more comprehensive "A Guide to Information Sources." It lists both general studies on CAI and some highly specific to engineering education.

Grayson, L.P. & Robinson, J. A Guide to Information Sources. In Grayson, L.P. & Robinson, J. U.S. Office of Education Support of Computer Project: 1965-1971, to be published by U.S. Govt. Printing Office, Fall 1971, 14 p., R.44.

This very recent guide to the literature on uses of computers in instruction is organized under the following headings: 1)Applications of Technology to Education; 2) Computers in Education: 3) Guides and Bibliographies, 4) Reviews and Major Reports, 5) Background Material. Altogether it contains 44 well annotated references together with costs and addresses for obtaining them.

Hansen, D.N. Current Research Development in Computer-Assisted Instruction. CAI Center Tech Memo. Florida State University, February 15, 1970. 23 p.

Computer-assisted instruction (CAI) is surveyed in terms of both the extent of research progress as well as the

degree of utilization for this new technological approach to education. After a brief review of some of the critical terminology used to describe research progress within CAI, the paper develops a conceptual framework by which to consider current investigatory efforts. The first section deals with the psychological nature of the CAI situation. The second introduced concepts of how CAI provides for individualization of instruction. Third, it introduces the procedures and research findings for the use of instructional strategies. The paper concludes with a discussion of learner strategies and their growing importance within CAI in learning investigations.

Hansen, Duncan N. Computer Assistance with the Educational Process. In Weisgerber, Robert A. (Ed.), Instructional Process and Media Innovation. Chicago: Rand McNally & Co., 1968, pp. 465-481. B.-65.

Examines: Meaning of CAL and recent technological history thereof; theories of student-machine communication in computer concept; CAI connotations of terms, hardware and software; current projects or experiments, and how these relate to future psychological research.

Holland, W.B. and Hawkins, M.L. Technology of Computer Uses in Instruction. The Emerging Technology. Santa Monica, California: Rand Corporation, September, 1970, pp. 370-459.

This report attempts to take stock of the capabilities that the computer has thus far demonstrated, a state-of-the-art. To do this, 3 techniques are used: A synoptic view of achievements, problems and trends in computer uses in instruction; a description of the network of institutions and activities from which the current state-of-the-art had developed; and a detailed review of each mode of computer use in instruction and a summary of the state of of development of each one.

Hornig, Donald F. (Chairman). Computers in Higher Education. Report of the President's Science Advisory Committee. Washington, D.C.: The White House, February 1967, 79 p. B.-0.

Produced by a 13 member PSAC panel, the report examines computers and under-graduate education, the computer science students, the interaction between research and educational uses of computers and the computer and secondary education. Among the guidelines and recommendations: about 75% of undergraduates could either use computers substantially in their courses or could benefit from some computer training. Faculty member should know more about computers, and for this, intensive 2 to 6-week courses would help. Universities and Governments should jointly form large educational computing facilities each serving several institutions. Various inducing means and more Government funding are recommended.

Levien, R.E. (Ed.). Computers in Instruction: Their Future for Higher Education, R-718-NSF/CCOM/RC. Santa Monica, California: The Rand Corporation, 221 p.

This is the proceedings of a conference held in October, 1970, sponsored by National Science Foundation, Carnegie Commission on Higher Education, and the Rand Corp. Participants consisted of 150 individuals from higher education, industry, and government. The starting point of the conference was recognition that the rate of growth of actual instructional computer uses will not be determined principally by the rate of advance of the instructional state of the art, but rather by the institutional context within which instructional use will occur. The goal of the conference was to identify decisions that should be made to facilitate the growth of instructional use of the computer.

Levien, R.E. Instructional Use of Computers. The Emerging Technology. Santa Monica, California: Rand Corp., September, 1970, pp. 56-86. B.-17.

This report is divided into two sections, Instruction About Computers, and Instruction With Computers. In the first section, the computer itself is a subject of study. Instruction about computers falls into three categories: specialist courses, service courses, and survey courses. In the second section, the computer is treated as a tool in instructional activities. Three categories of computer participation in the instructional process are: performance uses, management uses, and comprehensive uses. In

performance uses, the computer may be an aid to the student, performing such tasks as presenting instructional material, perfecting skills, and as an aid in independent learning. It may also be an aid to the teacher by providing classroom demonstrations, providing students with first-hand learning experiences, and by simulation and games. Management uses include monitoring and recording, and testing and prescribing. A comprehensive use is one in which a selection of programs that provide performance aids, management aids, or a combination of both is available within a single system making it considerably more flexible.

Levien, R.E. (Ed.). The Emerging Technology: Instructional Uses of the Computer in Higher Education. Santa Monica, California: Rand Corporation, September, 1970, P 465, B.-78.

This report contains Sections I & II of a study sponsored by the Carnegie Commission on Higher Education, The National Science Foundation and the Rand Corp. Section I is an introduction to the computer's use in higher education, and Section II deals with the state-of-the-art of computer use in instruction. This report is intended for an audience comprised of higher education policy makers in gov't., in colleges and universities and in industry. The audience is assumed to know little of the computer or its campus uses.

Molnar, A.R. Critical Issues in Computer-Based Learning. Washington, D.C.: National Science Foundation. November, 1970, 17 pages, B.-12.

In view of the growing use of computers in education (70% of all college students are enrolled in situations where there is a computer of some kind for instruction, for example), the author has cited several critical issues that must be dealt with in the near future. These include: The computer as a tool or a medium; evolution or revolution in the internalization of computer use; centralization or decentralization of the system; cost benefits; the role of the Federal government, which to date has been a case of too little time and too inflexible a policy. The most critical issue to be faced in the next 5 years is whether we will be satisfied to tolerate the current inadequacies of our educational system or whether we will seek to use educational technology to meet the educational and social

needs of society.

Molnar, A.R. Educational Technology--The White Elephant. Washington, D.C.: U.S. Office of Education, March 11, 1969, 19 p.

A ten year experiment in educational technology demonstrated the feasibility of large-scale educational systems which can extend education to all while permitting the individualization of instruction without significant increase in cost (through television, computer systems, microform techniques, and multi-media programming). Adoption of new technology has been slow, however, due to its high cost to small school districts, the loss of local autonomy involved in accepting regional systems, and willingness to invest in systems of unproven success in the field. The fragmented nature of education tends to restrict the spread of new technology, especially to small or remote districts and to minority groups, where its effect would be greatest in guaranteeing a minimum level of education. Quality materials must be developed for presentation, and larger cost accounting units are needed. Media use is ineffective unless the whole educational system is geared to take advantage of it: what is now needed are development projects to organize these research findings into effective systems.

Thornton, James W., Jr., Brown, James W., New Media and College Teaching. Washington, D.C.: American Association for Higher Education, Dept. of Audiovisual Instruction, 1968, 189 p.

Five hundred current innovative media projects in 300 colleges and universities are reported here by faculty members responsible for them. These reports are the basis for state-of-the-art evaluations, and both evaluations and reports are arranged in this study by fields: instructional television; mediated self-instruction; special multi-media facilities; transparencies; telephone applications; simulation systems; and media services management. Introductory comments relate media to their instructional use and this study to one in 1963, "New media in higher education." Some of the concluding remarks are that: applications seem to be more adaptive than creative, credible materials

of instruction need to be developed nationally and regi-- onally, and housing of media is still inadequate. Indices by topic, contributor, and institution are provided. A "Media activity inventory-directory," the product of two nationwide mail surveys (1966-67) is appended; it is arranged by state, institution, and media project leader.

Tondow, Murray. The Emerging Educatonal Triad: Man-Machines and Instruction. In Weisgerber, Robert A. (Ed.), Instructional Process and Media Innovation. Chicago: Rand McNally & Co., 1968, pp. 482-501. R.-14.

Examines: concept of man-machine system, and roles and responsibilities; implications of this form of automation in society and in education; distinction between CAL and learning about computers; prospective computer use in diverse school situations, from instruction to counseling and peripheral applications.

Weisgerber, Robert A. Higher Education and Media Innovation. In Weisgerber, Robert A. (Ed.), Instructional Process and Media Innovation. Chicago: Rand McNally & Co., 1968, pp. R.-42.

Examines: how well colleges and universities have led in adopting innovative teaching practices; teacher, learner, and media relationships in college and university setting; support for media service centers for systems approach to instructional development; developing trends in role of educators and in use of technology.

2. Critical Issues in CAL dealing with developmental needs, appropriate limitations and usages of C.A.L. in general are contained in the following listing:

Audio Utilization Convention and Techniques for Computer Assisted Instruction. Fort Monmouth, N.J. 07703: Army Signal Center and School, March, 1970, 48 p.

The report presents a set of guidelines for the immplementation of the audio mode in computer assisted instruction. It contains a collection of conventions and techniques synthesized from recent publications in areas pertinent

to multi-media audio-visual presentation. These areas include audio message placement, positioning, frequency, repetition, content and length in addition to device interplay, voice, vocabulary, tape preparation, audio script characteristics and listener instructions. Although prepared specifically for the incorporation of audio in the presentation of basic electronics subject matter by computer assisted instruction, the contents of this report may be applicable to non-technical as well as other technical subject matter.

Bushnell, Don D. Introducing the Docile Technology in Memoriam of CAI. In Tickton, S.G. (Ed.), T.I.L. pp. 161-178. B.-20.

The most common mode for the use of computers in education is for the student to be directed by the programed stimulus of the computer. This method has failed to solve the long-standing problems of education. The author suggests that the time-shared computer assisted instruction console should be used as a problem-solving tool for the student. He sees the computer as a tool for experimentation in new subject matters and as a simulator of unfamiliar environments. He finds the use of computers for drill and practice and tutorial projects to be inefficient. He discusses modifications that must be made in the mediation process if the student is to use the computer effectively. In the appendix several short papers discuss further uses for computers in education. A bibliography is appended.

Commission on Education National Academy of Engineering. Educational Technology in Higher Education: The Promises and Limitations of ITV and CAI. A report of the Instructional Technology Committee. September, 1969, pp. 22. B.-50.

Report includes background coverage of ITV and CAI utilization in higher education. Included are descriptions of a number of project and experiments in CAI utilization and results from research done in CAI effectiveness.

Kent, William P. (Prin. Invest.), In Cooperation with the Wichita Public Schools. Feasibility of Computer-Assisted Elementary Keyboard Music Instruction. Final Report.

Falls Church, Virginia: Systems Development Corp., March 1970, 158 p.

A study was made to determine the feasibility, infeasibility, or deferred feasibility of adapting a computer-assisted instruction (CAI) system to an existing non-automated program for providing keyboard experiences to elementary school children. A systematic task-by-task approach was adopted for the study: learning objectives were assessed, the present keyboard experience program (in Wichita public schools) was studied at first hand, an analysis was made of the applicability of existing computer-related technology, preliminary design alternatives were formulated, and designs were subjected to feasibility testing and evaluation. Three computer-based designs were developed, tested, and evaluated: an instructional management system, an advanced CAI system, and an intermediate approach. Significant conclusions which emerged from the study include that a CAI keyboard experiences system is susceptible only in part to the solutions being found for CAI systems in other educational areas, that the interactive CAI keyboard systems is most technologically feasible but is not economically feasible, and that a keyboard experience program involving automated non-computerized methods for individualized instruction is both economically and educationally feasible, and should be implemented.

Coulson, John E. Computer-Assisted Instruction and Its Potential for Individualizing Instruction. In Tickton, S.G. (Ed.), To Improve Learning pp. 197-210, B.-10.

For the next ten years, at least, it would almost certainly be prohibitively expensive for a student to receive a major part of each day's instruction in a direct individual dialogue with a computer. Furthermore such a system would not teach a student to interact effectively with other humans, to communicate the results of his labors to others, or to exchange ideas in attempts to solve shared problems. For the present, the computer is most useful in its role of a general purpose information processing system. Individualized instruction allows the mode, content and sequence of instruction to be tailored to the individual's needs at any moment in time. A computer is an important tool in individualizing instruction. The computer can be used as a teaching machine, a problem solving tool, or as a tutorial system. The remainder of this paper is a survey of the state of the art in computer-based tutorial systems

with special reference to the work being done at the system development corporation. A short list of references is provided.

Seidel, R. J. Computers in Education: The Copernican Revolution in Education Systems. Computers and Automation, 1969 Vol. 18, No. 3, (HumRRO Professional Paper 16-69, May, 1969. 6 pages.)

Predicts great success in the use of computerized education and training systems. The author believes that man will have to relinquish his egocentric role in teaching to be replaced by inter-disciplinary instructional teams in the design of contents of courses. The system for information exchange between learner and knowledge will become far more explicit, more efficient, and more reliable through the use of computers.

Starkweather, John A. Adaptive Machine Aids to Learning. In Tickton, S.G. (Ed.), T.I.L. pp. 353-364. B.-22.

With emphasis on man-machine relationships and on machine evolution, computer-assisted instruction (CAI) is examined in this paper. The discussion includes the background of machine assistance to learning, the current status of CAI, directions of development, the development of criteria for successful instruction, meeting the needs of users, requirements for a computer system to handle conversational interaction, feedback and adaptation of machine systems, the choice of man or machine for educational tasks, and the likely results of increased machine intelligence on instruction.

3 ystems Development

Studies concerned with the development of systems, dealing mainly with hardware, interfacing of components, and development of appropriate machine languages and conventions appear in the following:

Bitzer, Donald L. and Skaperdas, D. The Design of an Economically Viable Large-Scale Computer-Based Education system. In Levie, R. E. (Ed.), Computers in Instruction: Their Future for Higher Education. Santa Monica, Calif.: The Rand Corp., pp. 14-34.

Using newly developed technological devices it is economically and technically feasible to develop large-scale computer-controlled teaching systems for handling 4,000 teaching stations which are comparable with the cost of teaching in elementary schools. The teaching versatility of a large-scale computer is nearly limitless. Even while simultaneously teaching 4,000 students, the computer can take advantage of the 50 percent idle time to perform data processing at half its normal speed. In addition, 16 hours per day of computer time is available for normal computer use. The approximate computer cost of 12 cents per student contact hour pays completely for the computer even though it utilizes only 1/6 of its computational capacity. The remaining 5/6 of its capacity is available at no cost.

Bond, N. A. and Rigney, J. W. Specification of Training Objectives for Computer-Aided Instruction. Technical Report. Los Angeles: Univ. of Southern Calif., 1970. 31 p.

The specification of training objectives and the organization and implementation of courses around such objectives is becoming a significant part of instructional technology. Here is a brief review of some of the background for this development in earlier, related activities of job and task analysis. Requirements for the specification of training objectives are discussed. The implications of data-processing technology for improved control over the specification and implementation of training objectives are illustrated in an example of how computer programs can generate criterion task specifications from relatively simple data bases, and compare student performance

with these criterion tasks at a response-by-response level.

Carter, Launor F. Educational Technology -- Computer - Related and People-Related. *System Development Corporation, August 19, 1969. 23 p. B-8
*Santa Monica, Calif.

Two aspects of Educational Technology are considered. The first involves the development of Educational Technology highly dependent on computer equipment, and the development of a computer assisted instruction language called programmed language for interactive teaching (Planit). The second aspect involves the development of Educational Technology which is quite unrelated to equipment. The example given concerns an attempt to develop a tutorial community which is not related to hardware or equipment but rather to techniques of instruction, student-teacher relationships, and community interaction.

Kent, William P., and others. Feasibility of Using an Experimental Laboratory for Identifying Classroom Multi-Media Problems and Requirements. Final Report. Falls Church, Va.; System Development Corp., 1968,111 p.

Multimedia can significantly improve education, but only to the extent that their impact is perceived and plannned for planning might be accomplished in a comprehensive, multimedia development Laboratory, organized around methodology and functions rather than equipment or facilities. Such a Laboratory might plan, supervise, evaluate, and influence the implementation of complete educational systems making optimum use of multimedia and telemedia in an integrated and continuous manner. Of possible simulation Laboratories, a semi-manual computer-based Laboratory might be the most effective, but its main contribution would be as a research vehicle; it would not bring about major changes. The methodology of this study consisted of seeking expert opinions, visits to innovative installations, and a review of the multimedia state-of-the-art. No experiments were undertaken, nor was a prototype Laboratory built or tested. Annual cost of a comprehensive, multimedia development Laboratory is roughly estimated at $2,000,000. It is recommended that the Commission on Instructional Technology favorably consider the feasibility of such a Laboratory. A Bibliography and descriptions of various operations presently making use of multimedia are appended.

Molnar, A.R. The Computer and Curriculum Analysis. Paper presented at the Organization for Economic Cooperation and Development, Center for Educational Research and Innovation Conference on "The Instructional Uses of Computers in Education", Paris, France, March 19, 1970. 38 pages. B-28

Curriculum designers have derived data for instructional purposes from 1) The subject matter, 2) society, and 3) the Learner. The computer plays an instrumental role in individualizing the presentation of curriculum derived from these sources. Research on instruction has concerned itself with devising material for individual needs and adapting them to meet the necessities of group instruction. Computer assisted instruction, computer managed instruction, and simulation programs have been developed for a wide variety of subjects. Another significant development in curriculum design has been the systems approach which uses the tools of task analysis and behavioral objective statements to design an individualized instructional strategy. A consideration of national and regional manpower requirements, combined with content analysis of a total curriculum is but one approach to developing a dynamic curriculum. Interactive empirical procedures seem to produce more effective instructional materials. In order to minimize costs of a computer facility, regional computer networks have been established on an experimental basis. A list of references is appended.

Seidel, R.J. & Kopstein, F.F. Resource Allocations to Effect Operationally Useful CAI. Alexandria, Va.: Human Resources Research Organization, April 1970 16 p.

Resources allocations, in terms of funds, people, facilities and the delegation of appropriate authority to formulate appropriate policy for research and development and implementation of computer-assisted instruction are discussed. A description and justification of CAI as a technology is included. The need for incorporating a systems approach to educational innovation is stressed. A partnership among industry (profit and nonprofit), government and education is suggested as a model and a national network of multidisciplinary centers is advocated as the vehicle for accomplishing the goals fo research, development, and implementation of effective and efficient CAI systems.

Stolurow, Lawrence M. Some Factors in the Design of Systems for Computer-Assisted Instruction. Cambridge, Mass.: Harvard Univ., May 1968. 45 p.

Computer Assisted Instruction (CAI) can achieve its potential as a tool for individualizing instruction only if the flexible logic and memory capabilities of computers are utilized. An instructional program must be written in such a way that it can handle at least three variables: (A) who is being taught; (B) what is critical; and (C) How the teaching is to be done. The program must also be capable of choosing the most effective mode of instruction in a given instance: problem solving, drill and practice, inquiry, simulation and gaming, or tutorial instruction. Student response data constitute an additional variable. An idiographic model may be a useful approach to considering both the prescriptive and descriptive aspects of programmed instruction. Useful techniques for achieving individualization and student participation may be seen in studies involving the use of cailan (CAI Language) and symbolic logic as the teaching material. A Bibliography supplements the text.

Training Methodology, Part IV: Audiovisual Theory, Aids & Equipment. Public Health Service Publication #1862, Part IV, Public Health Service (DHEW). Washington, D.C.: Health Svcs & Mental Health Admin., 1969. Annotated bibliography; 89 p.

A total of 332 annotated references pertaining to media aspects of training are organized under the following headings: (1) Audiovisual theory and research, (2) Audiovisual methods (General), (3) Audiovisual equipment (General), (4) Computers in instruction, (5) Television instruction, (6) Videotape recordings, (7) Television facilities, (8) Radio instruction, (9) Telephone instruction, (10)Film instruction, (11) Film sources, (12) 8-millimeter films, (13) Filmstrips, (14) Slides, (15) Audiotape recordings, (16) Overhead projections, transparencies, (17) Visual Aids--Design and use, (18) Facilities, (19) Learning Resource Centers, (20) Multimedia Instruction--Rationale, (21) Multimedia facilities and equipment, (22) Auto-instructional Laboratories, (23) Dial Access retrieval systems, (24) some administrative factors, and (25) Guides, other sources. A subject index provides further assistance in locating entries.

a. Interactive Systems

Studies dealing primarily with provision for making systems interactive follow:

Carbonell, Jaime R. Mixed-Initative Man-Computer Instructional Dialogues. Final Report. Cambridge, Mass.: Bolt Beranek & Newman, May 1970. 217 p.

In order to show that a new type of programming for Computer Assisted Instruction (CAI) is feasible, the Scholar system was written. It is information structure oriented, based on the utilization of a symbolic information network of facts, concepts and procedures. It can generate out of its information network the material to be presented to the student, the questions to be asked of him, and the corresponding expected answers. Scholar can also utilize its information network to answer questions formulated by the student. This report gives the motivation and background for developing the program. A technical discussion of CAI programming languages in general, and current implementations of the Scholar program. Some conclusions and recommendations for further research complete the report.

Hammer, Carl. The Future: Interactive Electronic Systems. In Levien, R.E. (Ed.), Computers in Instruction: Their Future for Higher Education. Santa Monica, Calif.: The Rand Corp., 1968, pp. 3-8.

Using the Delphi technique, a technology forecast was made to determine the future of electronic systems technology. Twelve of approximately 1000 events are listed, dated and described. This twelve item list is limited to electronic engineering. The future in a cybernetic society as opposed to the present automated society is described.

Lambe, Edward D. How Will Computers Come to Affect College Level Instruction? In Levien, R.E. (Ed.), Computers in Instruction: Their Future for Higher Education. Santa Monica, Calif.: The Rand Corp., 1968, pp. 108-113. R-4.

Computers may affect instruction in higher education through three routes: through academic areas when computers and associated techniques are themselves subjects of instruction, such as science, mathematics, engineering or computing; through disciplines in which high speed computation might reasonably alter the emphasis and procedures used in teaching them; and through instruction in which the computer is not involved except as it mediates portions of the instruction procedure.

Stetten, Kenneth J. The Technology of Small, Local Facilities for Instructional Use. In Levien, R.E. (Ed.), Computers in Instruction: Their Future for Higher Education. Santa Monica, Calif.: The Rand Corp., 1968, pp. 35-41.

Until recently, it was believed necessary to invoke the economics of large computer size to achieve cost economy of less than 40 cents per terminal-hour for highly interactive, fast, and effective CAI and CMI classroom service. The recent development of the TICCET system (which

stands for Time-Shared Interactive Computer-Controlled Educational Television) has shown that quite similar and, in some ways, even better classroom service can also be provided by a small computer and at the same predicted cost per student. These costs represent an approximate cost reduction of 10 to 1 over a number of previous CAI/CMI systems.

Stewart, J.C. Rascal: A Rudimentary Adaptive System for Computer-Aided Learning. (Master's thesis, Naval Postgraduate School) Monterey, Calif.: December 1970. 152 pages.

The requirements of a Computer Aided Learning System which would be a reasonable assistant to the teacher are discussed. These ideas are implemented in a system entitled RASCAL, a Rudimentary Adaptive System for Computer Aided Learning. RASCAL replaced prepared frames used in previous systems with a description of questions to be asked and a tree of alternatives that might be helpful in assisting a student in answering a question. The actual questions are generated as a function of the system's interaction with a student, as is the selection of the branch to follow in aiding the student. The results obtained to date, while not extensive in their scope, indicate that a system such as RASCAL can be useful in the classroom.

Zinn, Karl L., A Comparative Study of Languages for Programming Interactive Use of Computers in Instruction. Final Report. Univ. of Michigan, Ann Arbor, Mich.: Center for Research, Learning, and Teaching, Feb. 1969, 229 p.

A clearly defined and formal method for comparative analysis and evaluation of computer author languages would permit the worker in computer-based instruction to select a language by its effectiveness for the task rather than its easy availability. Such a comparative framework is put forward in this study. The report identifies the useful features of various languages and their support systems, gives categories for the easy description of all languages, and identifies the requirements of authors, teachers, and students which are not being met in existing languages. Four kinds of languages are discussed-- those based on a presentation of successive frames, conversation within a limited context, presentation of curriculum files by standard procedures, and data analysis and revision of materials. A glossary of terms defines the major useage in computer-based instruction and defines those used in the eight categories. The major documents of the study appear in the six appendices, including information on specific languages and sample programs.

b. Provision for Simulation and Gaming

Studies dealing primarily with simulation and gaming appear below:

Adair, C.H., Hansen, D.N., Rayner, G.T., & Agarwal, A. Two Simulated Inquiry Environments: A Social Simulation Game and a CAI-Based Information Retrieval System. Tallahassee, Fla.: Florida State University, CAI Center, May 30, 1970. 79 pages.

Building upon an earlier collection of social science generalizations and the development of a taxonomic retrieval system, the study has implemented an information retrieval (IR) system within a computer added instruction system, developed a social simulation game, constructed an attitude scale to appraise three affective factors within the game and IR learning tasks, and a studied teachers inquiry behavior. An experiment was designed and executed within the game and IR system to further examine the outcomes of the attitude scale and to examine human inquiry behavior more closely.

Coleman, James S. The Role of Modern Technology in Relation to Simulation and Games for Learning. In Tickton, S.G. (Ed.). T.I.L. 1971, pp. 183-196.

Brief descriptions of simulation and games and their relationship to each other are given, followed by a discussion of how they can best be used for learning. A comprehensive bibliography of groups engaged in the development of simulation games, and of simulation games that have been develcped concludes the article.

Thomas, David B. CAI Center Tech Memo. Two Applications of Simulation in the Educational Environment. Tallahassee, Fla.: Florida State University CAI Center. February 26, 1971. 27 p.

Computer-based learning simulations are a relatively recent development within the educational process. The paper focuses on the simulation techniques that allow for interactive responding via a time-shared computer terminal. Two simulations which provide a laboratory-like means for student involvement with complex quantitative models are discussed in the context of an individualized environment. STATSIM, exercises in statistics, permits the student to explore simulated representations of descriptive and inferential statistics relating to sampling distributions, the concepts of Type I and Type II errors, and the sequential nature of hypothesis testing. The simulation of mathematical learning models provides a student laboratory for investigation of associative learning. The paper concludes with a discussion of an experimental investigation of student control of instructional sequence in which learning simulations were employed as learning materials. The results suggested that naive students may show increased performance when permitted learner control over instructional sequence.

4. Other Special Applications

Studies dealing particularly with a) Engineering and Science Education, b) Medical Education, c) Language Instruction, follow:

a. Engineering and Science Education

Bitzer, D. L., Blomme, R.W., Sherwood, B.A., & Tenczar, P. The Plato System and Science Education. Urbana, Illinois. University of Illinois. August, 1970. 17 p.

This report gives examples of diverse educational strategies in science and engineering to illustrate the capabilities of the Plato III computer-based education system. The basic structure of the tutor language is discussed and some technical details are given to explain how the Plato III system works. A brief description of the large-scale Plato IV system now under development is also given.

Grayson, Lawrence P. An Introductory Guide for Engineering Teachers on Uses of Computers in Instruction. In Engineering Education. March, 1970. 8 p. B.-28.

This is a section of the authors more comprehensive "A Guide to Information Sources". It lists both general studies on CAI and some highly specific to engineering education.

Howard, James A. On the Use of an Interactive Computer System in Engineering Education. Proceedings of the IEEE. 1971, 59 (6), 969-974. B.-11.

The University of California, Santa Barbara, On-Line System (OLS) provides a flexible and highly interactive vehicle for instruction in many engineering subjects. The system capabilities and instructional potential are discussed and illustrated by examples. Student motivation and comprehension are increased markedly by OLS use. The system is currently being used in subjects including complex variables, networks, controls, and hydrodynamics. The OLS is exportable to many IBM 360 systems and the cost is within the means of most engineering departments.

Huelsman, Lawrence P. Educational Aspects of Computer-Aided Design. Proceedings of the IEEE. 1971, 59 (6), 975-979. B.-27.

Several general approaches to the use of the digital computer in the teaching of engineering design are discussed. These approaches are 1) the use of existing programs, 2) the development of programs specifically designed to solve a certain type of problem, and 3) the development of general-purpose software packages designed to implement the material and techniques taught in a specific course. The advantages and disadvantages of these various approaches are discussed and specific examples of each approach are given.

b. Medical Education

Bitzer, Maryann D. and Boudreaux, Martha A. Using a Computer to Teach Nursing. Hillsdale, New Jersey: Nursing Publications, Inc. 1969. 21 P. B.-4.

Nurses at Mercy Hospital, Urbana, Ill., are receiving a major part of their instruction via PLATO, a computer-based educational system. This involves a series of 22 lessons in which the student performs experiments, gathers data and answers questions. Results of tests show that PLATO students learned the same amount of material in one-third to one-half the time required in classrooms.

Farquhar, J.A., Bretz, R., Ginsberg, A.S., Lincoln, T.L., Mellone, R.J. and Mills, G.F. Applications of Advanced Technology to Undergraduate Medical Education. Santa Monica, Calif.: Rand Corporation, April, 1970. pp. 79. B.-2.

Advanced technology will have a great effect on medical education because it can speed up medical education and boost the quality of instruction without straining the capacity of medical schools to expand or driving costs to unreasonable levels. Six examples of an application of advanced technology to medical education are described in the report: Computer Assisted Instruction (CAI), Computer Assisted Self Evaluation, Ultra-Microfiche Retrieval and Display, Electronic Video Recording (EVR), and two multimedia aids known as the "Clinical Encounter Simulator" and the "Patient Management Decision Aid". The questions are raised that must be answered prior to any attempt at widespread implementation of the systems described. The remainder of the report is concerned with sketching out directions for future research. Two examples of the form and possible results of such research are provided. An appendix estimates the costs of setting up a microform medical library system with equipment for search, retrieval and use of information.

c. Language

Adams, E.N. Computer-Based Instruction and Management in Foreign Language Training: A Systems Concept. Yorktown Heights, New York: IBM Research, 8 Oct., 1969. 21 p. B.-8.

A language-learning system is described in which individual practice in the learning laboratory is the central activity, both of learning and of testing. The system includes as one component an audio/visual device controlled by a digital computer. The system is designed to achieve a high quality

of instruction by good management of the student's time and effort. A discussion is given of the equipment, computer programs, and the general functional design of the learning system.

Hocking, Elton and Smith, W.F. Language Laboratory Teaching and Learning in the United States. Frankfurt Am Main, Germany: Verlag Moritz Diesterweg, 1969.

Presented in this article are trends in the use of the language laboratory in the United States and an overview of relevant language laboratory research. A section on trends discusses language laboratory popularity. Prospective technological innovations, scheduling, different types of installations, and the increasing desirability of having "library arrangements" with many listening stations. Another portion dealing with research describes experiments completed on (1) laboratory usefulness, (2) effective scheduling practices, (3) suitable equipment, (4) monitoring techniques, (5) "dial-a-lesson" and telephone facilities, and (6) programed and computer-assisted instruction. Bibliographical notations and a list of useful expressions in both English and German precede an article summarization in German.

Ofiesh, Gabriel D. Ed.D. Dial Access Information Retrieval Systems: Guidelines Handbook for Educators. Final Report. Washington, D.C. Office of Education, July, 1968. p. 152. B.-84.

A survey of the status of dial access systems is presented. The emphasis is on educational utilization. Design, equipment and costs are considered. A list of hardware and software suppliers is provided and hardware specifications are compared. Existing and planned systems (as of 1968) are listed.

5. Economics of CAI

Particular studies dealing with the Economics, Cost/Effectiveness, Cost-Benefit Analysis or Comparative Efficiency at CAI with other instructional methods follow:

Alpert, D., & Bitzer, D.L. Advances in Computer-Based Education, Science, 1970 167, 1582-1590. B.-15.

A computer-based education system, Plato IV, with a projected target cost of about 35¢ per student-contract hour is described. This cost ranges up to one-twentieth that of some current systems in use. Exploratory research with Plato III suggests the new medium will be educationally effective and enthusiastically received.

Bitzer, Donald L. and Johnson, Roger L. PLATO: A Computer-Based System Used in the Engineering of Education. Proceedings of the IEEE, 1971, 59 (6), 960-968. B.-18.

Research results obtained with the PLATO computer-based education systems indicates that computer technology can be effectively applied to some of the problems of our present educational system. The research results and system designs reported are based upon studies in computer-based education which have included over 150,000 student contact hours in a variety of subjects and educational levels. Also included are a description of some new hardware developments which are necessary to the realization of an economically viable system, and a discussion of the economic and educational considerations which should influence the design of any computor based educational system.

Bitzer, D., & Skaperdas, D. The Design of an Economically Viable Large-Scale Computer Based Education System. Urbana, Illinois. University of Illinois: February, 1969. 17 p.

This report describes the development of an economically viable teaching system using a computer-based education system. The PLATO system, used at the University of Illinois for the past nine years, is discussed. The authors report that by using newly-developed technological devices it is economically and technically feasible to develope large-scale computer-controlled teaching systems for handling 4000 teaching stations. The cost of instruction would be comparable to the cost of teaching in elementary schools.

Committee for Economic Development, Research and Policy Committee. Innovation in Education: New Directions for the American School. New York, New York: July, 1968. 74 p. B.-12.

The future of American schools depends in large part on their openness to innovations in instructional patterns, in school organization, in education for teachers and for deprived minorities, and in their use of educational technology. Basic and applied research are needed to determine useful innovation. Cost-benefit and cost-effectiveness analyses are needed to determine its practicality. The goals of instruction must be continually re-examined and revised in light of changing conditions and new possibilities. Educational equipment and new methods in themselves may influence these goals. To stimulate change a national commission on research, innovation, and evaluation in education is recommended. Memoranda of comment, reservation, and dissent are appended.

Cost Study of Educational Media Systems & Their Equipment Components, Vol. II. Technical Report. Final Report. General Learning Corp., Washington, D.C.: June 1968. 334 p.

A three-dimensional matrix is developed to account for costs involved in production, distribution, reception, initial operation, and environment for airborne TV, ITFS, satellite TV, UFH TV, CCTV, video tape recording, film, radio, language laboratories and dial access systems.

Cost Study of Educational Media Systems and Their Equipment Components, Vol. III: A Supplementary Report: Computer Assisted Instruction. Final Report. Washington, D.C.: General Learning Corp., May, 1968. 114 p.

CAI is described within the context of a computer-model of cost/education. CAI equipment costs are defined on the basis of their functions. The study concludes that the costs of CAI are currently so high that it can be justified only if it becomes the dominant mode of instruction in a given instructional environment.

Geisert, P. A Comparison of the Effects of Information Mapped Learning Materials and Traditional Materials on the Learning of Concepts via the Printed Page and Computer Cathode Ray Tube. Tallahassee, Fla.: Florida State University CAI Center, October 30, 1970. 85 p.

The effects of information mapping and information mapped feedback on achievement, time variables, and attitude were investigated in a study utilizing the printed page and computer-assisted instruction. A systems approach was used to develop a set of hierarchically arranged learning materials. Forty-four members of the Army National Guard of Tallahassee served as subjects to compare information mapped materials with traditional materials. No significant differences were found in the comparison of 15 dependent variables. (These variables included such measures as reading time on booklet, time spent reading instructions, scores, time spent on sentence or paragraph classification, etc.) Significant differences were demonstrated for all attitudes toward the material, with the subjects showing more positive attitudes toward information mapped materials than traditional materials. A trend in performance and time variables suggested that information mapped/feedback treatment resulted in better performance. (Author)

Molnar, A. R. Media and Cost-Effectiveness. Transactions of Analog/Hybrid Computer Educational Users Group, 1970. 11 (10), pp. 291-298.

Instructional media systems might be of help in meeting the educational crisis of today, but it is difficult to

find systems which reached the potential demonstrated in pilot efforts. Some of the more obvious reasons for the failures in educational technology are these: There is research but not development, equipment but no materials, a market but no customer, money but not enough, programs but no systems, and there is the belief of educators that teachers should have autonomy. Questions that represent an approach to cost effectiveness in the use of educational media are these: all things being equal, what does it cost? What can I buy for a small increment in cost? What is the critical mass necessary to produce educational results? Can I find others to share the cost? Can the rules be rewritten so that the price is right? Some of the difficulties in applying cost effectiveness analysis to education are that education is an open system: effectiveness, not efficiency is the better criterion; financing may be difficult, and so may measurement. What is needed to make educational technology effective is the critical mass to produce quality materials and regional networks for large audiences. Media systems, utilizing television and computers, will be used when they come to be regarded as necessities.

6. Future Predictions of CAI Development

The studies below deal with predictions of developments related to CAI expected to take place in the future. Several contain Scenarios of education in the years from the late 70's through 2001 AD.

Alpert, Daniel. Computers and the Future of Education. In Levien, R.E. (Ed.), Computers in Instruction: Their Future for Higher Education. Santa Monica, Calif.: The Rand Corp., 1971, pp. 114-123.

This report discusses some of the substantive educational issues which must be faced with particular emphasis on how computer-based education can provide an effective and economically viable mechanism for addressing many unmet educational needs. Three issues are discussed: 1. the need for a whole new approach to increasing educational productivity; 2. the need to counteract the fragmentation of knowledge; and 3. the need for powerful new approaches to the solution of problems of society. The PLATO IV program in computer-based education is described, along with major changes in higher education that would be made possible by a PLATO-like system.

Computers: New Era for Education? National School Public Relations Association. Washington, D.C., 1968, 24 p. B.-25

This is an overview for the general reader of some present and future uses of the computer in education. Included are: descriptions of CAI at several grade levels; different subject matter where CAI is used; implications of CAI, which appear to indicate that widespread use of CAI will come about through further education of teachers and administrators as to the computer's capabilities, etc.

Levien, R.E. (Ed.). Computers in Instruction: Their Future for Higher Education, R-718-NSF/CCOM/RC. Santa Monica, Calif.: The Rand Corp., 1971, 221 p.

This is the proceedings of a conference held in October 1970, sponsored by National Science Foundation, Carnegie Commission on Higher Education, and the Rand Corp. Participants consisted of 150 individuals from higher education, industry, and government. The starting point of the conference was recognition that the rate of growth of actual instructional computer uses will not be determined principally by the rate of advance of the instructional state of the art, but rather by the institutional context within instructional use will occur. The goal of the conference was to identify decisions that should be made to facilitate the growth of instructional use of the computer.

Levien, Roger E. Instructional Uses of the Computer in Higher Education. In Levien, R.E. (Ed.), Computers in Instruction: Their Future for Higher Education. Santa Monica, Calif.: The Rand Corp., 1971, pp. 162-175.

Sections of this report include: objectives for instructional computer use; computer capabilities and costs, including hardware and software; provisions of computer service; and provisions of instructional materials. Effects on higher education will be evolutionary rather than revolutionary. If a viable national market for instructional materials is created, the chance of an evolutionary growth of instructional computer uses occurring is good. Possibly development of computer-based instruction will take place most rapidly outside of higher education and the campus will be in the position of responding to those developments. Recommendations for government, industry and higher education based upon objectives of national policy concerning instruction with the computer conclude this report.

Feingold, Samuel L. CAI Systems Past, Present, and Future. Washington, D.C.: System Development Corporation, February 11, 1970, 9 p.

In looking back at the development of CAI systems at System Development Corporation over the past eleven years, one can see a pattern of interaction between advances in computer hardware and software and continuing efforts to solve the basic problems of CAI--problems of keeping the cost low, making coding and editing easier, achieving a natural-language capability--that existed from the beginning. As new equipment and higher-level languages became available, solutions to one or another of these basic problems became feasible. Now, in the fourth "generation" of CAI, we have on-line time-sharing capabilities, and a flexible language that embodies both program logic and instructional content. This pattern gives some hint of how things will proceed into the future.

Grayson, L.P. Computer-Assisted Instruction and its Implications for University Education. In: The Application of Technology to Education. Washington, D.C.: American Society for Engineering Education, 1969, pp. 7-12. R.-26.

Contains an excellent description of CAI, what it is, and deals with problems and suggested solutions in the areas of 1. hardware, 2. software, 3. effectiveness, 4. implementation. Following this, the author deals with the future growth and great promise for CAI.

Hansen, D.N. CAI Center Tech Memo. The Role of Computers in Education During the 70's. Tallahassee, Fla.: Florida State University, CAI Center, May 15, 1970. 15 p.

The concept of an information management system is presented in order that the major educational functions can be conceptionally and operationally integrated within one computer center during the seventies. These major informational functions include: 1. information retrieval of administrative data; 2. scientific computing; and 3. computer supported instruction via computer-managed instruction, computer-assisted instruction, and learning simulation. The primary need for more sophisticated training of professional staff and support for personnel within educational institutions is discussed in great detail. The paper concludes with an economic analysis of some of the computer alternatives opened for support of instruction.

Leonard, G.B. Visiting Day 2001 AD. In Education and Ecstasy. New York: Dell, 1968, 22 p., Chs 8 & 9.

These two chapters present a scenario of a school for 3-10 year olds in the year 2001. A short history of free learning is given, beginning with the establishment of Summerhill in 1924 through the present educational innovations to projected developments yet to come. A description of the learning environments devices and techniques in use at the school follows. All electronic devices described are technically feasible at present.

Tschirgi, Robert D. The Effect of Computers on Higher Education. In Levien, R.E. (Ed.), Computers in Instruction: Their Future for Higher Education. Santa Monica, Calif.: The Rand Corp., 1971, pp. 124-130.

Technologically sophisticated service industries will soon employ a majority of the labor force. This will require revisions in organization, methology, and curricular content at all levels of education. On the basis of current evidence, a fully coordinated and integrated educational system utilizing all presently available technologies for information-handling will be needed to effectively meet the crisis of numbers and quality in higher education. To meet the criterion of cost effectiveness, the system must be developed on a large base, and academic expertise will be used for necessary research in learning theory and development of curriculua and programs. Several changes which may be expected in higher education are described in detail.

7. Key Projects

The following studies are primary documents describing some of the key projects in CAI today.

Bitzer, Donald L. and Skaperdas, D. The Design of an Economically Viable Large-Scale Computer-Based Education System. In Levien, R. E. (Ed.), Computers in Instruction: Their Future for Higher Education. Santa Monica, Calif.: The Rand Corp., pp. 14-34.

Using newly developed technological devices it is economically and technically feasible to develop large-scale computer-controlled teaching systems for handling 4,000 teaching stations which are comparable with the cost of teaching in elementary schools. The teaching versatility of a large-scale computer is nearly limitless. Even while simultaneously teaching 4,000 students, the computer can take advantage of the 50 percent idle time to perform data processing at half its normal speed. In addition, 16 hours per day of computer time is available for normal computer use. The approximate computer cost of 12 cents per student contact hour pays completely for the computer even though it utilizes only 1/6 of its computational capacity. The remaining 5/6 of its capacity is available at no cost.

Carbonell, Jaime R. Mixed-Initiative Man-Computer Instructional Dialogues. Final Report. Cambridge, Mass.: Bolt Beranek & Newman, May, 1970, 217 p.

In order to show that a new type of programing for computer assisted instruction (CAI) is feasible, the Scholar system was written. It is information structure oriented, based on the utilization of a symbolic information network of facts, concepts, and procedures. It can generate out of its information network the material to be presented to the student, the questions to be asked of him, and the corresponding expected answers. Scholar can also utilize its information network to answer questions formulated by the student. This report gives the motivation and background for developing the program, a technical discussion of CAI programing languages in general, and current implementations of the Scholar program. Some conclusions and recommendations for further research complete the report.

Environment Learning System: The "Talking Typewriter." New York: Responsive Environment Corp., 1968, 8 p.

The use of this proprietary equipment in special educational applications (physically handicapped, disadvantaged persons, etc.) is described.

Hansen, D. N., Brown, B. R., O'Neil, H. F., Merrill, P. F., & Johnson, B. F. CAI Center Annual Progress Report--January 1, 1970 through December 31, 1970. Tallahassee, Fla.: Florida State University, March 31, 1971. 38 pages.

This document concisely describes the research and development activities of the Computer-Assisted Instruction Center, Division of Instructional Research and Service, Florida State University. It includes a brief narrative indicating the nature and future directions of the various programs of research, abstracts of the studies performed, and results accomplished during calendar year, 1970.

Project IMPACT--Computer-Administered Instruction: Description of the Hardware/Software Subsystem. Alexandria, Va.: Human Resources Research Organization. December, 1970, 50 pages.

Project IMPACT is a comprehensive advanced development project designed to produce an effective and economical computer-administered instruction (CAI) system for the Army. In this report the computer hardware and software capabilities of the prototype system are described. The components of the computer hardware/software subsystem are discussed in terms of the four main activities they support. These activities are: administering instruction to students, courses, and instructional decision models; performing administrative functions in a school.

Stewart, J. C. Rascal: A Rudimentary Adaptive System for Computer-Aided Learning. (Master's thesis, Naval Postgraduate School). Monterey, Calif.: December, 1970, 152 pages.

The requirements of a Computer Aided Learning System which would be a reasonable assistant to the teacher are discussed. These ideas are implemented in a system entitled RASCAL, a Rudimentary Adaptive System for Computer Aided Learning. RASCAL replaced prepared frames used in previous systems with a description of questions

to be asked and a tree of alternatives that might be helpful in assisting a student in answering a question. The actual questions are generated as a function of the system's interaction with a student, as is the selection of the branch to follow in aiding the student. The results obtained to date, while not extensive in their scope, indicate that a system such as RASCAL can be useful in the classroom.

Stetten, Kenneth J. The Technology of Small, Local Facilities for Instructional Use. In Levien, R. E. (Ed.), Computers in Instruction: Their Future for Higher Education. Santa Monica, Calif.: The Rand Corp., 1971, pp. 35-41.

Until recently, it was believed necessary to invoke the economics of large computer size to achieve cost economy of less than 40 cents per terminal-hour for highly interactive, fast, and effective CAI and CMI classroom service. The recent development of the TICCET system (which stands for Time-Shared Interactive Computer-Controlled Educational Television) has shown that quite similar and, in some ways, even better classroom service can also be provided by a small computer and at the same predicted cost per student. These costs represent an approximate cost reduction of 10 to 1 over a number of previous CAI/CMI systems.

Thornton, James W., Jr., Brown, James W, New Media and College Teaching. Washington, D.C.: American Association for Higher Education, Dept. of Audiovisual Instruction, 1968, 189 p.

Five hundred current innovative media projects in 300 colleges and universities are reported here by faculty members responsible for them. These reports are the basis for State-of-the-Art evaluations, and both evaluations and reports are arranged in this study by fields; instructional television, mediated self-instruction, special multimedia facilities; transparencies, telephone applications, simulation, systems, and media services management. Introductory comments relate media to their instructional use and this study to one in 1963, "New media in higher education." Some of the concluding remarks are that: applications seem to be more adaptive than creative, credible materials of instruction need to be developed

nationally and regionally, and housing of media is still inadequate. Indices by topic, contributor, and institution are provided. A "Media activity inventory-directory," the product of two nationwide mail surveys (1966-67) is appended; it is arranged by state, institution, and media project leader..

Wastler, B. J. (Ed.). Project REFLECT Annual Report, June, 1968 to June, 1969. Rockville, Md.: Montgomery County Public Schools, 1969. 135 pages.

Although computer applications in the commercial and scientific realms have expanded tremendously, only a small number of the computers in the public schools are utilized for instructional purposes, and an even smaller number are capable of CAI applications. The terminal objective of project REFLECT is the design of a model plan which could be utilized by other public school systems in the implementation of validated and feasible CAI technologies. Project REFLECT is designed to answer questions such as: which basic CAI techniques and strategies are effective in the public school environment for which specific subject matter disciplines and for what student target populations? Which CAI applications can be shown to be effective in the public school environment for which specific subject matter disciplines and for what student target populations? Which CAI techniques, strategies, and applications are feasible for the immediate future? What resources (personnel, materials, equipment, money, etc.) and planning are necessary to implement those feasible CAI applications identified in question three? The activities to date deal with planning, equipment, staff development and modular instructional packages.

8. Other CAI references.

The following listing contains other articles or reports which appear by title, author, or issuing group to be significant. At the time of publication of this review, they have not been available for review, and therefore are listed, as referred to by others in the materials searched for this report.

Adams, E.N. Technical Considerations in the Design of a CAI Computer System. In Annett, John and Duke, John (Eds.), Proceedings of a Seminar on Computer Based Learning Systems, Session II: Hardware and Engineering Problems. Leeds Univ., Sept., 1969. London: National Council for Educational Technology, 1970. pp. 9-17.

Adams, E.N., Morrison, H.W., and Reddy, J.M. Conversation with a computer as a technology of language instruction. Modern Language Journal, 1968, LII (1).

Alberga, Cyril N. Educational Software Characteristics. Yorktown Heights, N.Y.: IBM, December 19, 1969. 19 p.

Allen, William H. A Course of Study and Bibliography For Instruction in Educational Media Research & Theory. Final Report. U.S.O.E. March, 1969. 170 p.

Annett, John and Duke, John (eds.) Proceedings of a Seminar on Computer Based Learning Systems. Leeds University, Sept., 1969. London: National Council for Educational Technology, 1970.

Apter, Michael J. The New Technology of Education. London, England: MacMillan and Co. Ltd., 1968, 144 p.

Atkinson, Richard C. Computer-Assisted Instruction: A Book of Readings. Calif.: Stanford Univ. School of Education, 1969. 362 p.

Atkinson, Richard C. and Suppes, Patrick. Program In Computer-Assisted Instruction. Final Report. Stanford Univ., Calif. Aug., 1968. 95 p.

Barnes, O.D. A Computer Assisted Instruction: Annotated Bibliography. Bloomington, Ind.: Phi Delta Kappa, Inc., Sept., 68. 21 p.

Becker, James W. Run Computer Run: A Critique. Philadelphia, Pa.: Research for Better Schools, Inc. 1968. 45 p.

Bitzer, Donald L. and Skaperdas, Dominic. The Design of an Economically Viable Large-Scale Computer-Based Education System. In Ticketon, S.G. (Ed.). T.I.L. V. 2. pp 439-454.

Committee for Economic Development, Research and Policy Committee. Innovation in Education. New Directions for the American School. New York: July, 1968. 86 p.

Cost Study of Educational Media Systems and Their Equipment Components, Vol III: A Supplemental Report: Computer Assisted Instruction. Final Report. Washington, D.C.: General Learning Corp., May, 1968. 114 p.

Dunn, W.R. and Holyroyd, C. (Eds.) Conference on Programmed Learning and Educational Technology Volume II. London, England: Methuen Educational Co. Ltd. 1969. 677 p.

Environment Learning System. The "Talking Typewriter." New York: Responsive Environment Corp., 1968. 8 p.

Feurzeig,W. and Others. Programming-Languages as a Conceptual Framework for Teaching Mathematics. Cambridge, Mass.: 1969. 329 p.

General Learning Corp. Cost Study of Educational Media Systems & Their Equipment Component, Vol. II. Technical Report. Final Report. Washington, D.C.: June,1968. 334 p.

Hickey, Albert E. Computer-Assisted Instruction: A Survey of the Literature. 3rd ed. Newburyport, Mass.: Entelek, Inc. October, 1968. 160 p.

James H. Thomas and others. The Schools and the Challenge of Innovation. New York: Committee for Economic Development, Jan. 1969. 369 p.

Karweit, Nancy, and Livingston, Samuel A. Group vs. Individual Performance and Learning in a Computer Game: An Exploratory Study. Baltimore, Md.: John Hopkins Univ., September, 1969. 26 p.

Kay, Harry and others. Teaching Machines & Programmed Instruction. Baltimore, Md.: Penguin Books, 1968. 173 p.

Knirk, Frederick G. (Ed.) Instructional Technology; A Book of Readings. New York: Holt, Rinehart & Winston, 1968. 300 p.

Lange, Phil C. Programmed Instruction; The Sixty-sixth Yearbook of the National Study of Education. Part II. Chicago, Ill.: Nat'l Society for the Study of Education, 1967. 459 p.

Markle, Susan Meyer. Programming and Programmed Instruction. In Tickton, S.G. (Ed.), T.I.L. pp. 293-298. B.-8

McGowan, William N. New Directions for School Administration Burlingame, Calif.: Calif. Assoc. of Secondary School Administrators, January, 1969. 157 P.

Mitzel, Harold E. How to Evaluate Computer Assisted Instruction. University Park, Pa.: Pennsylvania State University, November 1970. 6 p.

Moeller, Hans Today is Not Yet Tomorrow. Philadephia, Pa. Media & Methods Institute, Inc., October 1968. 4 p.

Mondadori, Alberto (Ed.) Automation and Educational Problems. Milan, Italy: Federation of Scientific and Technical Assoc., April 1969. 296 p.

Morgan, Robert M. A Review of Educational Applications of the Computer, including those in Instruction, Administration and Guidance. Stanford Univ., Calif.: Eric Clearinghouse on Ed. Media and Technology, August 1969. 13 p.

Oettinger, Anthony G.; and Marks, Sema. Run, Computer, Run. Cambridge, Mass.: 1969. 302 p.

Parkus, Lawrence. Computer Assisted Instruction in Elementary/ Secondary Education: The State of the Art. In Tickton, S.G. (Ed.). T.I.L. pp. 323-338.

Pincus, Margaret E. Some Essays on Computers in Education. Cambridge, Mass.: Harvard Univ., 1967. 118 p.

Sherman, Mark A., and Klare, George R. Attitudes of Adult Basic Education Students Toward Computer-Aided Instruction. Cambridge, Mass.: Harvard Univ., May, 1970. 17 p.

Shuford, Emir. H., Jr. and Masengill, H. Edward. The Worth of Individualizing Instruction. Lexington, Mass.: Shuford-Massengill Corp., November, 1966. 34 p.

Simmons, Robert F. Linguistic Analysis of Constructed Student Responses in CAI. Austin, Texas: Texas University, October, 1968. 31 p.

Smallwood, Richard D. Optimum Policy Regions for Computer-Directed Teaching Systems, 1968. 33 p.

Suppes, Patrick; and others. Computer-Assisted Instruction: Stanford's 1965-66 Arithmetic Program. Calif.: Stanford Univ., Institute for Mathematical Studies in Social Science, 1968. 385 p.

Wade, Serena E., Media and the Disadvantaged - A Review of the Literature. Stanford Univ., Calif.: ERIC Clearinghouse on Educational Media & Technology, March, 1969. 26 p.

SOPHISTICATION INDEX

This index presents a listing of articles concerning Computer Augmented Learning, in three levels of sophistication. These levels are defined as follows:

Level 1 - Introductory material.

Level 2 - Requires basic knowledge and awareness of terms.

Level 3 - Requires extensive background knowledge in the area, plus technical or analytic background (usually of interest to the specialist).

Level 1

Alpert, D., and Bitzer, D. L. Advances in Computer-Based Education.

Apter, Michael J. The New Technology of Education.

Atkinson, Richard C. Computer-Assisted Instruction: A Book of Readings.

Barnes, O. D. A Computer Assisted Instruction: Annotated Bibliography.

Becker, James W. Run Computer Run.

Bitzer, Maryann D. and Boudreaux, Martha A. Using a Computer to Teach Nursing.

Committee for Economic Development, Research and Policy Committee. Innovation in Education: New Directions for the American School.

Environment Learning System. The "Talking Typewriter."

Feurzeig, W. et al. Programming-Languages as a Conceptual Framework for Teaching Mathematics.

Health Services and Mental Health Administration. Training Methodology, Part IV: Audiovisual Theory, Aids and Equipment.

Hickey, Albert E. Computer-Assisted Instruction: A Survey of the Literature.

Hornig, Donald F. (Chm.). Computers in Higher Education.

Kay, Harry et al. Teaching Machines and Programmed Instruction.

Knirk, Frederick G. (Ed.). Instructional Technology: A Book of Readings.

Leonard, G. B. Visiting Day 2001 A.D.

Levien, R. E. (Ed.). The Emerging Technology: Instructional Uses of the Computer in Higher Education.

McGowan, William N. New Directions for School Administration.

Mitzel, Harold E. How to Evaluate Computer Assisted Instruction.

Moeller, Hans. Today is Not Yet Tomorrow.

Molnar, A. R. Critical Issues in Computer-Based Learning.

Molnar, A. R. Educational Technology--The White Elephant.

Molnar, A. R. Media and Cost-Effectiveness.

National School Public Relations Association. Computers: New Era for Education?

Oettinger, Anthony G. and Marks, Sema. Run Computer Run.

Ofiesh, Gabriel D. (Ed. D.). Dial Access Information Retrieval Systems: Guidelines Handbook for Educators.

Pincus, Margaret E. Some Essays on Computers in Education.

Seidel, R. J. Computers in Education: The Copernican Revolution in Education Systems.

Shuford, Emir H., Jr. and Masengill, H. Edward. The Worth of Individualizing Instruction.

Smallwood, Richard D. Optimum Policy Regions for Computer-Directed Teaching Systems.

Thomas, James H., et al. The Schools and the Challenge of Innovation.

Wade, Serena E. Media and the Disadvantaged.

Level 2

Adair, C. H., Hansen, D. N., Rayner, G. T., and Agarwal, A. Two Simulated Inquiry Environments: A Social Simulation Game and a CAI-Based Information Retrieval System.

Allen, William H. A Course of Study and Bibliography for Instruction in Educational Media Research and Theory.

Alpert, Daniel. Computers and the Future of Education.

Annett, John and Duke, John (Eds.). Proceedings of a Seminar on Computer Based Learning Systems.

Atkinson, Richard C. and Suppes, Patrick. Program in Computer-Assisted Instruction.

Bitzer, Donald L. and Johnson, Roger L. PLATO: A Computer-Based System Used in the Engineering of Education.

Bitzer, D., and Skaperdas, D. The Design of an Economically Viable Large-Scale Computer-Based Education System.

Bond, N. A. and Rigney, J. W. Specification of Training Objectives for Computer-Aided Instruction.

Bushnell, Don D. Introducing the Docile Technology in Memoriam of CAI.

Carter, Launor F. Educational Technology--Computer-Related and People-Related.

Coleman, James S. The Role of Modern Technology in Relation to Simulation and Games for Learning.

Commission on Education, National Academy of Engineering. Educational Technology in Higher Education: The Promises and Limitations of ITV and CAI.

Committee for Economic Development, Research and Policy Committee. Innovation in Education. New Directions for the American School.

Coulson, John E. Computer-Assisted Instruction and Its Potential for Individualizing Instruction.

Dunn, W. R. and Holyroyd, C. (Eds.). Conference on Programmed Learning and Educational Technology, Volume II.

Farquhar, J. A., Bretz, R., Ginsberg, A. D., Lincoln, T. L., Mellone, R. J., and Mills, G. F. Applications of Advanced Technology to Undergraduate Medical Education.

Feingold, Samuel L. CAI Systems Past, Present, and Future.

General Learning Corporation. Cost Study of Educational Media Systems and Their Equipment Components, Vol. II.

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Grayson, L. P. Computer-Assisted Instruction and Its Implications for University Education.

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Hammer, Carl. The Future: Interactive Electronic Systems.

Hansen, Duncan H. Computer Assistance with the Educational Process.

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Hansen, D. N., Brown, B. R., O'Neil, H. F., Merrill, P. F., and Johnson, B. F. CAI Center Annual Progress Report - January 1, 1970 through December 31, 1970.

Hocking, Elton, and Smith, W. F. Language Laboratory Teaching and Learning in the United States.

Holland, W. B. and Hawkins, M. L. Technology of Computer Uses in Instruction.

Human Resources Research Organization. Project IMPACT--Computer-Administered Instruction: Description of the Hardware/Software Subsystem.

Karweit, Nancy and Livingston, Samuel A. Group Vs. Individual Performance and Learning in a Computer Game.

Kent, William P., et al. Feasibility of Using an Experimental Laboratory for Identifying Classroom Multi-Media Problems and Requirements.

Lambe, Edward D. How Will Computers Come to Affect College Level Instruction?

Lange, Phil C. Programmed Instruction: The Sixty-sixth Yearbook of the National Study of Education. Part II.

Levien, R. E. (Ed.). Computers in Instruction: Their Future for Higher Education.

Levien, Roger E. Instructional Uses of the Computer in Higher Education.

Markle, Susan Meyer. Programming and Programmed Instruction.

Molnar, A. R. The Computer and Curriculum Analysis.

Mondadori, Alberto (Ed.). Automation and Educational Problems.

Morgan, Robert M. A Review of Educational Applications of the Computer, Including Those in Instruction, Administration and Guidance.

Parkus, Lawrence. Computer Assisted Instruction in Elementary/Secondary Education.

Seidel, R. J. and Kopstein, F. F. Resource Allocations to Effect Operationally Useful CAI.

Sherman, Mark A. and Klare, George R. Attitudes of Adult Basic Education Students Toward Computer-Aided Instruction.

Starkweather, John A. Adaptive Machine Aids to Learning.

Stetten, Kenneth J. The Technology of Small, Local Facilities for Instructional Use.

Suppes, Patrick, et al. Computer-Assisted Instruction: Stanford's 1965-66 Arithmetic Program.

Thornton, James W., Jr., and Brown, James W. New Media and College Teaching.

Tondow, Murray. The Emerging Educational Triad: Man-Machines and Instruction.

Tschirgi, Robert D. The Effect of Computers on Higher Education.

Wastler, B. J. (Ed.). Project REFLECT Annual Report.

Weisgerber, Robert A. (Ed.). Higher Education and Media Innovation.

Level 3

Adams, E. N. Computer-Based Instruction and Management in Foreign Language Training: A Systems Concept.

Adams, E. N. Technical Considerations in the Design of a CAI Computer System.

Adams, E. N., Morrison, H. W., and Reddy, J. M. Conversation with a Computer as a Technology of Language Instruction.

Alberga, Cyril N. Educational Software Characteristics.

Army Signal Center and School. Audio Utilization Convention and Techniques for Computer Assisted Instruction.

Bitzer, Donald L. and Skaperdas, D. The Design of an Economically Viable Large-Scale Computer-Based Education System.

Bitzer, D. L., Blomme, R. W., Sherwood, B. A., and Tenczar, P. The Plato System and Science Education.

Carbonell, Jaime R. Mixed-Initiative Man-Computer Instructional Dialogues.

Environment Learning System. The "Talking Typewriter."

Geisert, P. A Comparison of the Effects of Information Mapped Learning Materials and Traditional Materials on the Learning of Concepts via the Printed Page and Computer Cathode Ray Tube.

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This index presents a listing of the authors of significant articles on various aspects of educational telecommunications. It indicates, by author, the number of articles annotated in this literature search in each educational/telecommunications category. The categories are as follows:

ETS - Educational Telecommunications System

ITV - Instructional Television

CATV - Cable Television

CCTV - Closed Circuit Television

ITFS - Instructional Television Fixed Service

VTR - Video Tape Recording

E/IR - Educational/Instructional Radio

TI - Telephone Instruction

DAIRS - Dial Access Information Retrieval System

INS - Information Network Systems

CCS - Communications Satellite System

CC - Common Carrier

CAL - Computer Augmented Learning

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